ILLUSTRATED
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## VIEWS, NEWS AND INTERVIEWS.

A special commission has arrived in San Francisco, authorized by the Japanese Government, to study the workings of electric power and telephone systems in the United States. The commission is composed of S. Mine, R. Natayama and Y. Wadachi. They will be on the Pacific coast until about June 1 and then will come East.

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All sorts of physiological effects produced by X rays have been recorded since the Roentgen boom, but the announcement that they are likely to cause baldness is calculated to spread dismay amongst those who have been experimenting closely with the Crookes tube, says the London *Lancet*. In a preliminary experiment to ascertain the possibility of photographing a bullet in the head of a child it was found that 21 days after the experiment all the hair came out in the region exposed to the X-ray discharge. If the time that elapses before positive baldness was effected could be reduced what an incalculable benefit would Roentgen's discovery confer on shavers. Thus to remove the beard would only require the placing of a Crookes tube for a few minutes over the chin before retiring to rest, when next morning the ordinary application of soap and water would complete the operation. Under these circumstances the "new barber" may not impossibly be one of the many outcomes of the "new photography."

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The prices of crude rubber have ranged considerably higher during the past year because of large consumption for bicycle and other tires and for electrical uses.

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A few years ago, when the electric light was young, a customer came to Tesla in great haste, and exclaimed: "I am having a great deal of trouble with those *congested* lights. I think it is caused by the *complicator*, for it is sparking all the time." This suggestion of the early attempts to say "incandescent" and "commutator" will bring up similar reminiscences to the minds of many pioneers.

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The route east of London taken by the message sent by Mr. E. D. Adams to Mr. Depew at the National Electrical Exposition on May 16 was as follows:

| | | | MILES. |
|---|---|---|---|
| London | to | Porthcurno, Land's End | 250 |
| Land's End | " | Lisbon | 876 |
| Lisbon | " | Gibraltar | 336 |
| Gibraltar | " | Malta | 1,126 |
| Malta | " | Alexandria | 913 |
| Alexandria | " | Suez | 154 |
| Suez | " | Aden | 1,403 |
| Aden | " | Bombay | 1,850 |
| Bombay | " | Madras | about 500 |
| Madras | " | Penang | 1,497 |
| Penang | " | Singapore | 398 |
| Singapore | " | Saigon | 630 |
| Saigon | " | Hongkong | 991 |
| Hongkong | " | Foochow | 473 |
| Foochow | " | Shanghai | 459 |
| Shanghai | " | Nagasaki | 1,341 |
| Nagasaki | " | Tokio | about 600 |
| Total | | | 13,677 |

Some of these stations were passed in transmitting, but just how many is not known.

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Judging by suggestions made on the subject, some people lately have been desirous of getting beryllium (glucinum) used in some way in electrical work, remarks an exchange. Up to the present, its light weight and high conductivity have been mainly insisted upon, but it is now stated that its coefficient of expansion is the same as that of platinum, and therefore it could be used instead of the latter in incandescent lamps. There is, however, the lower melting point of beryllium to consider before that is done.

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Mr. Charles A. Coffin has retired from the board of directors of the United States Rubber Company.

## How To Make and Use a Tesla High-Frequency Coil.

TO THE EDITOR OF ELECTRICAL REVIEW:

In hopes to aid your correspondent "F. P. L." * in the matter of a Tesla high-frequency coil, I beg to offer my experience, gained after long search.

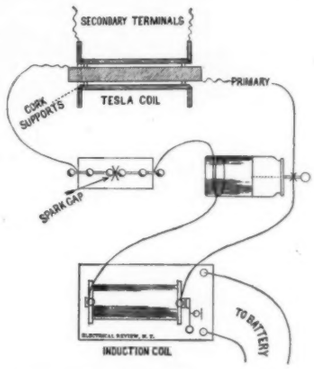



FIG. 1.—SECTIONAL VIEW OF TESLA COIL.

Go to some reliable wood turner and have a spool turned of three and one-half inches, outside diameter, with the interior turned out two and one-half inches diameter. Have a solid piece turned on which to wind your primary, two inches diameter and 14 inches long. The length of the first hollow spool should be 12 inches. It would be well to have the first spool one-half inch longer at each end, or 13 over all, but turned down one-quarter inch deep and of a width of one-quarter inch, so that a check block can be turned to slip on the end of the outer spool for appearance sake, and to which the terminals of the secondary wire can be led. The rough sketch herewith, Fig. 1, will give you the proper idea.

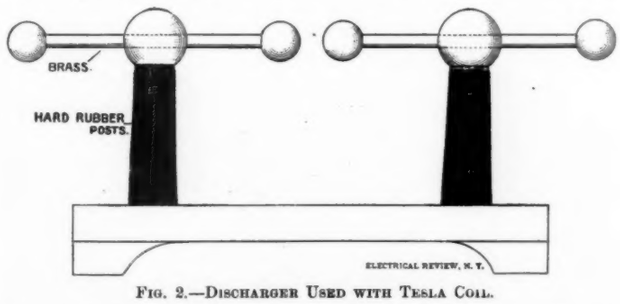



FIG. 2.—DISCHARGER USED WITH TESLA COIL.

For the primary, wound on the solid core, use No. 18 double cotton-covered wire wound in a single layer, with the ends being fastened to the core and left with plenty of projecting wire. For the secondary, use No. 36 double silk-covered wire carefully and compactly wound across the outer spool in a single layer. After winding, both the inner coil and the outer should be carefully shellaced; and it would be well, as I have done, to boil all wood pieces in paraffine before winding.

Such a coil can be operated for high-frequency effects by an ordinary spark coil giving at least two-and-one-half-inch spark. To do this you will require a Leyden jar ordinarily known as a half-gallon jar. The discharge of the jar must be made through the primary circuit of the Tesla coil and care must be taken to arrange the wires so that you will not short-circuit the induction coil. I have endeavored to sketch you the ordinary form of discharger (Fig. 2), with well polished balls which must be drawn apart to the limit of the sparking distance of your Leyden jar. Another way would be to keep the discharging balls tolerably near together and use an air blast across the gap when the coil is in operation. The effects by this latter method are much greater.

To give the Tesla effects, the Tesla coil should be placed in an oil-tight wooden box and covered with oil; otherwise the streams formed will pass through the coil sectionally and occasion a great loss of energy.

A Crookes bulb, which I can not operate with my three-inch spark coil *alone*, fluoresces readily when the Tesla coil is operated by the same induction coil. Yours truly,

ELLIOTT WOODS.

Washington, D. C., May 14.

* See "A Disruptive Coil Wanted," ELECTRICAL REVIEW, May 13, 1896.

## OBITUARY.

Charles Stowell, for 20 years an assistant of the late Prof. Moses G. Farmer, died recently at his home in Charlestown, Mass.

# THE ELECTRICAL EXPOSITION.

## A Week of Interest and Large Attendance.

THE EDISON X-RAY BOOTH THE DRAWING CARD, WHILE ALL THE EXHIBITORS ARE PLEASED WITH THEIR NUMEROUS CALLERS—AN UNPLEASANT NEWSPAPER MISTAKE—GREAT THINGS EXPECTED THIS WEEK—THE EXPOSITION'S FINANCIAL SUCCESS ASSURED — MORE ABOUT THE VARIOUS DISPLAYS.

At the close of the Electrical Exposition Saturday evening last the final footing up of the receipts showed an even balance of expense and income. With this week's receipts to count as a surplus, it is safe to say that the Exposition will prove to be a financial success. As has already been demonstrated, it has proven to be an electrical and scientific one. The attendance has increased and many new faces are to be seen every night, as well as many familiar ones, who return again and again.

The schools of this and surrounding cities have been offered special inducements, and General Manager Stump had his hands full on Friday looking after the interests of some 600 of these enthusiastic visitors. Every afternoon this week will be devoted to the work of interesting and entertaining the schools, and special lectures will be provided.

The one unpleasant feature of the week was the appearance of the *Electric Railway Gazette*, containing charges against the Exposition to the effect that the claim of the transmission of electric power from Niagara Falls, which had been widely announced, was untrue. The paper, after stating the transmission in question was impossible under the conditions given, concluded its editorial attack in these words :

"This attempt, it is needless to state, was a failure, and the present success savors so strongly of fake that either a detailed expert electrical explanation of the conditions or a most abject apology for a gigantic fraud is due the public."

The editor of the paper, when brought before the indignant Executive Committee and shown that his surprising charges were without foundation, wrote and signed an apology and retraction, saying that he "was entirely mistaken in what he said."

The officers, however, decided that great injury had been done them and the exhibitors, as honorable men, and also to the Exposition Company, and commenced a libel suit against the W. J. Johnston Company, the publishers of the paper making the attack, in the sum of $50,000 in the Supreme Court, and papers were served on Friday last.

In another column is a brief communication, replying to these charges, from Mr. L. B. Stillwell, a well known and thoroughly reliable electrical engineer.

The interest this week will largely focus around the vacuum-tube lighting to be shown by Mr. Edison. The announcement in the ELECTRICAL REVIEW last week, that Tesla had perfected his vacuum-tube lighting apparatus, and that he would soon be ready to show it to the public, has greatly increased the interest in this beautiful branch of electrical research. Edison's work in this field will attract the greatest interest, and its public demonstration will be closely observed by the electrical fraternity, in person or by proxy, all over the world.

### GENERAL EXPOSITION NOTES.

The display of the Peru Electric Manufacturing Company, of Peru, Indiana, is a unique arrangement of the many electrical forms of porcelain and samples of the Hercules and Laclede batteries.

The John Burry telegraph printing system is one of the novelties at the Exposition which appeals strongly to the general public.

The heavy presses for cutting armature disks and other styles of presses made by the Farracute Machine Company, of Bridgeton, N. J., are shown in operation on the main floor in charge of Messrs. F. F. Smith and W. S. Mitchell.

The Bradfort Belting Company's booth, with Mr. Morris in charge, is one of the corners where entertainment is most generously dispensed.

The novel calculagraph, or time recording instrument, illustrated in connection with the telephone for showing elapsed time and calculating in money value the value of time, is one of the comparatively new inventions at the Exposition. The Calculagraph Company's exhibit is in charge of Mr. Abbott, the general manager of the company.

Various members of the National Carbon Company have been on from Cleveland in attendance at the company's exhibit.

The Anchor Electric Company, of Boston, are showing a most complete line of switches, sockets, cut-outs, cleats, lamps and the many electrical specialties of which they are the manufacturers. The company has been well represented by Messrs. Hawks, Reynolds, Field and Marshall.

The intercommunicating telephones, known as the auto-telephone system, which are installed for use throughout the building, are an interesting feature. The Tucker Electrical Construction Company, of New York, the manufacturers, have also a prominent exhibit showing the various types of this instrument.

The pretty effects shown by the prism globes made by the United States Glass Globe Company of the Havemeyer Building, New York, attracts crowds every evening.

The Thompson Meter Company, of Brooklyn, are showing the various types of water meters made by them.

For the student of electricity D. Van Nostrand & Company, 23 Murray street, New York, keep a supply of electrical and scientific literature published by them, on the main floor.

The Lewis Tool Company, 44 Barclay street, New York, are showing the patented vise recently perfected by them.

The Hamilton Tool Company, Hamilton, Ohio, have a number of their heavy machines on exhibition.

The exhibit of the Cutter Electric and Manufacturing Company, Philadelphia, of the "C-S" switches and automatic magnetic circuit-breakers, attracts much attention from practical electricians. Messrs. Cutter, Newton and Nicholson have been present.

The Electrozone Company, New York, have an elaborate exhibition of their products.

The improved type of switchboard shown by William F. Bossert, of Utica, is of general interest to the electricians interested in construction work.

The booth of the Peck Electrical Company, 15 Cortlandt street, New York, is one of the prominent exhibits. The company shows a line of the popular carbons, for electric lighting and other purposes, made by the American Carbon Company, also a line of the arc light specialties made by T. H. Brady, of New Britain, Ct. Captain Brady has been a frequent visitor in person. The Peck company have also various types of the well known Helios lamps, for which they are agents.

The Gamewell Fire-Alarm Company, New York, has a complete line of their systems of alarms on the main floor.

The extensive display of electrical and scientific instruments shown by J. C. Vetter & Company, of New York, is one of the most comprehensive exhibits of this nature.

The Columbia Rubber Works Company, New York, have a display of their large line of electrical designs, such as telephone receivers, push buttons and insulating tape.

The prominent exhibit of the Ball Electric Light Company, New York, includes several of the new type of the Ball double-armature dynamos.

The Columbia Incandescent Lamp Company and the Wagner Electric Company, both of St. Louis, have jointly one of the largest spaces on the main floor. The Wagner company have a complete line of their transformers and the house has had a number of its representatives present.

The New Haven Car Register Company, near the entrance on the main floor, have a number of their well known car registers on exhibition. Mr. John S. Bradley, secretary and treasurer of the company, has been a caller at the Exposition.

The Ideal Electric Company, New York, have on view in third balcony, near the Exposition office of the ELECTRICAL REVIEW, a number of the new La Roche direct and alternating machines and the Fleming-Spencer alternating lamps. Messrs. Poillon, Grannis and Fleming have represented the interests of the company.

The Taunton Locomotive Manufacturing Company, Taunton, Mass., have on the ground floor, in charge of Mr. B. W. Hayes, an exhibition of Wainwright feed-water heaters, condensers and boiler equipments.

The practical exhibition of the C. W. Hunt Company's coal conveyer in connection with the Abendroth & Root boiler in operation is a feature in the ground-floor exhibition.

The Williamsport Wooden Pipe Company, Williamsport, Pa., show the various forms of conduits which they manufacture. Mr. N. B. Bubb, the general manager, and Mr. See, the Philadelphia representative, have been at the Exposition.

The exhibition of magnesia sectional covering for steam pipes and boilers shown by Robert Keasby, of

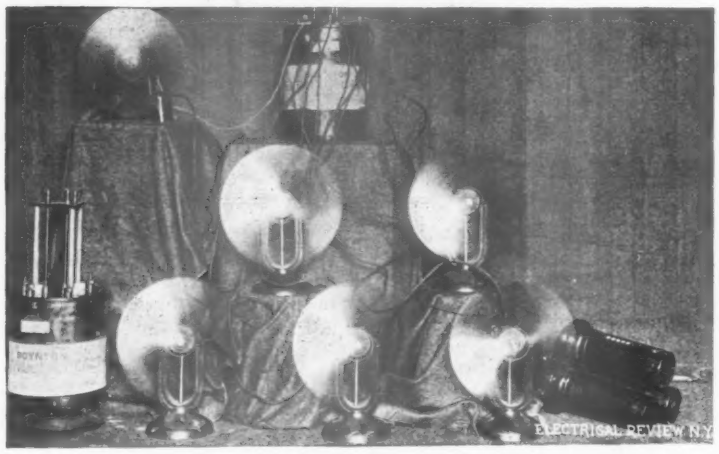



EXHIBIT OF BOYNTON MULTIVOLT BATTERY COMPANY, ELECTRICAL EXPOSITION, NEW YORK.

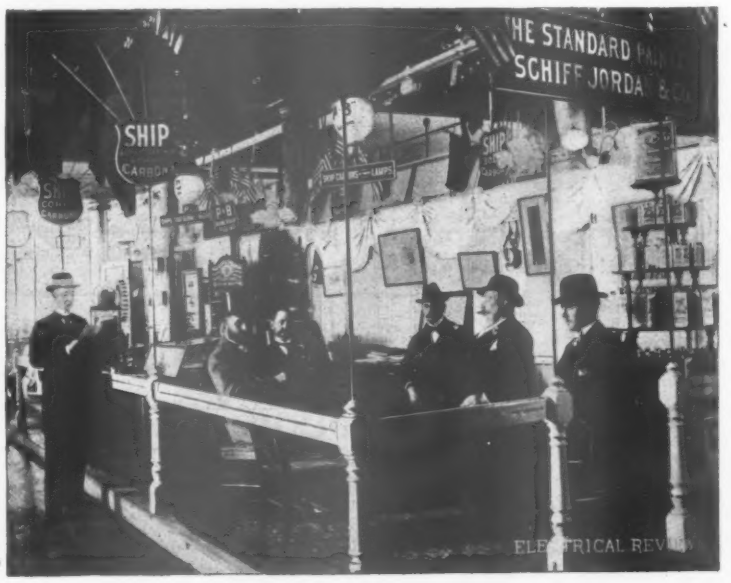



EXHIBIT OF THE STANDARD PAINT COMPANY, AT THE ELECTRICAL EXPOSITION, NEW YORK.

New York and Buffalo, is of interest to the power element.

The Telmic Company, of New Jersey, exhibits its fire-brick clay conduit in sections. Mr. W. H. Falconer is in charge.

Mr. C. H. McIntire, the well known electrical manufacturer of Newark, has an exhibit of the McIntire connectors, so popular in long-distance telephone circles.

The H. C. Jones Electric Manufacturing Company of West Twenty-ninth St., New York, has an interesting exhibit of his stage receptacle on the second floor. It consists of a double-pole switch and receptacle that can not be short-circuited by water or any other foreign substance that may be dropped on it. The wearing part is made of metal and is quite durable.

The Excelsior Electric Company has a remarkably fine exhibit of the widely known Hochhausen apparatus. One of his latest 125 arc light machines is in operation every evening and is viewed with interest by the many practical electric lighting men who are constantly in attendance. This exhibit is admirably located and the various machines are to be seen at a glance.

The Bryan-Marsh incandescent lamp exhibit is highly artistic and these gentlemen receive compliments on all sides for the beautiful work they show.

The Columbia Incandescent Lamp Company is admirably located and presents an assortment of the various lamps manufactured by this strong and successful company. President Rhotehamel was in attendance the first two weeks of the Exposition and met many friends of his popular product. The picture of Henry Goebel is strongly in evidence.

Mr. J. D. McIntire represents the enterprising house of Pass & Seymour, the Syracuse manufacturers of the well known Pass & Seymour specialties. This booth is a noticeable one, containing samples of every kind of goods they manufacture, all very neatly arranged. Among the new things exhibited is a porcelain socket which has attracted much attention from the electric light companies.

The Nowotony Electrical Company, Cincinnati, has a centrally located booth near that of the Diehl Manufacturing Company, and have their arc lamps, dynamos and motors on view.

The "Volta" battery exhibit of Dale, Farrell & Company, New York, has been a Mecca for visitors. The display of batteries in operation and the "X-ray" bicycle electric lamp are of interest to the general public.

The Warren Electric Company, of Chicago, has in operation, in charge of their New York representatives, Wendell & McDuffie, one of the new Warren alternators.

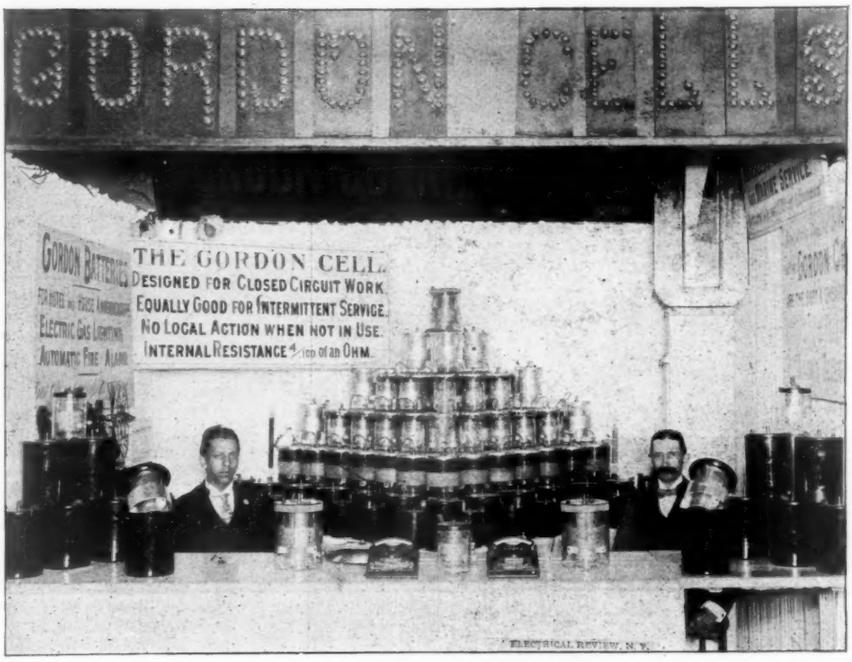

GORDON CELLS
THE GORDON CELL.
DESIGNED FOR CLOSED CIRCUIT WORK.
EQUALLY GOOD FOR INTERMITTENT SERVICE.
NO LOCAL ACTION WHEN NOT IN USE.
INTERNAL RESISTANCE 1/100 of an OHM.
GORDON BATTERIES
ELECTRICAL REVIEW, N. Y.

EXHIBIT OF THE GORDON-BURNHAM BATTERY COMPANY, OF NEW YORK, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

## Latest Improvements in Primary Batteries.

The trade has been awaiting the advent of a high-class primary battery which shall do the work required on closed as well as open circuits. Many attempts have been made to build a sal-ammoniac cell that shall not become polarized on a dead short circuit. The copper oxide has invariably been de-oxidized within a short time, often inside of 15 minutes or half an hour. A cell must contain an oxide of copper surface far in excess of all ordinary requirements in order to overcome this feature. The theoretically perfect battery is one where the copper element is in sheets as thin as a wafer, but the trouble has been that such a form packs in layers, and these masses act electrically as a solid, the exposed surfaces only becoming available.

The nearest approach to this ideal form is believed to be found in the Gordon-Burnham battery, now on exhibition at the Electrical Exposition. In this cell the copper element is in flakes and granules and the active surface is consequently enormously increased. The actual tests of the battery show that it will stand a dead short circuit trial of six hours without polarization, enough of the oxide remaining to carry on the work until the zinc element has been entirely consumed. This gives the largest possible electro-motive force on the one hand and great volume on the other. The care taken in the manufacture and preparation of the elements prevents the introduction of the carbons and stays all local action.

The test made by the New York Central at Mott Haven gave, for three Gordon cells as a track battery, 18 out of 24 hours practical short circuit work, and they stood the strain for 43 days without attention or renewal. The gravity cells in the same circuit required attention every 10 days. Superintendent of Signals John V. Young, of the Boston & Maine, reports tests by him, then incomplete, covering 73 days of continual work, without attention or renewal, and with the thermometer at 12 degrees below zero.

In order to ascertain the amperage capacity of copper prepared by this process, tests were made by E. A. Chapel, superintendent Chelsea Electric Light Company. He reports: "I am able to work from eight to ten switches simultaneously, while with S.— battery I have never been able to work more than four. The battery became short-circuited by one of the buttons in the key sticking and remaining so all one night. After clearing the trouble in the morning the switches went to work at once and worked as though nothing had happened."

These various tests, covering the whole field of efficiency for open or closed circuit work, certainly substantiate the claim for the value of the flake copper element, as well as the sodium solution used in the Gordon cell. It is estimated that their use has reduced the cost of production of electricity by primary batteries from 20 to 25 per cent, to say the least.

EXHIBIT OF THE BIRDSALL ELECTRIC MANUFACTURING COMPANY, ELECTRICAL EXPOSITION, NEW YORK.

EXHIBIT OF DEVEAU & COMPANY, OF NEW YORK, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

## STEAM BOILERS: THEIR EQUIPMENT AND MANAGEMENT.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, MAY 7, 1896, BY ALBERT A. CARY.

*(Continued from Supplement, page 6, "Electrical Review," May 20, 1896.)*

Each one of these methods has its own advantages and disadvantages, and the first one is probably the worst arrangement that could be made; in fact, it may be regarded as impracticable. An extremely large steam space is neither desirable nor necessary; it increases the size of the boiler unduly, as well as increasing the heat radiating surface. Our second method of caring for the very sudden demand for steam is by providing a large water capacity. Under these conditions a fall in pressure is depended upon to supply the steam required until the boiler is able to supply the demand continuously. With such an equipment, when the throttle is suddenly opened, admitting steam to the engine, the steam from the steam space of the boiler first rushes into the cylinder, and we will say, for example, that the boiler pressure drops from 100 to 80 pounds. Let us next assume that we are drawing our steam from a plant of boilers holding 100,000 pounds of water. The temperature of the water under 80-pounds pressure, we know, is 322.9 degrees Fahrenheit, while its temperature under 100-pounds pressure is 337.8 degrees Fahrenheit. By turning to our steam tables we find the total heat in one pound of water under the above conditions as follows:

One pound of water under 100 pounds of steam pressure contains 308.7 heat units.

One pound of water under 80 pounds of steam pressure contains 294.0 heat units.

Thus, when the pressure drops from 100 pounds to 80 pounds, the total heat required in each pound of water is less, by 14.7 heat units. Multiplying this by 100,000, we have 1,470,000 heat units available for the generation of steam. Divide this by 886.7 (the number of heat units necessary to evaporate one pound of water at 323.9 degrees Fahrenheit into steam), and we find that we have 1,658 pounds of water evaporated during the time of the reduction of the pressure from 100 pounds to 80 pounds. Now, if our engine uses 500 horse-power and 60 pounds of steam is required per hour per horse-power (equal to one pound of steam per minute per horse-power, or 500 pounds of steam per minute for 500 horse-power), we divide 500 into 1,658; we see that from this lowering of temperature or pressure, we liberate sufficient heat to supply our engine with steam for about three and one-third minutes, even though all other sources of heat are withdrawn, but this is not the case; the fire in the furnace will add its heat constantly at the same time, and thus we soon find an equilibrium established, and the boilers will finally be able to supply the engines steadily with the steam required.

Let us see how much of a boiler equipment we would need to cover the conditions we have just outlined. Let us suppose that we take horizontal tubular boilers 66 inches diameter and 18 feet long, containing 46 four-inch tubes. One boiler of this kind (allowing one-third of the diameter vertically to measure the steam space) will hold about 14,000 pounds of water. Dividing this into the 100,000 pounds of water we will find that it will require seven boilers, which, if rated by the regular builders' rating, would be sold as 668 horse-power.

EXHIBIT OF STANLEY & PATTERSON, OF NEW YORK CITY, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK.

This is about one-third in excess of the rated engine horse-power, but, considering the excessive duty called for in such service, it can be considered as a well balanced plant.

The third method of providing for a great and very sudden demand for a large quantity of steam is accomplished, as has been stated, by providing one or more large, hot water storage tanks, which are used in connection with one or more regular boilers, the principle of working in this case being the accumulating of large quantities of heat in the water held in these tanks under pressure, to be called upon when needed, for steam making purposes; a very similar principle to the storing of electricity in storage batteries, to be drawn upon at any instant when the current is needed. This is known as Halpin's system of thermal storage, and, in the case under consideration, its operation is almost identical to the second method just described; that is, it depends upon a fall in the steam pressure when the body of water gives up some of its heat, which results in the formation of steam at a lower pressure. In this system, of course, a fewer number of boilers are used, but the quantity of water handled by these boilers is proportionally greater.

EXHIBIT OF THE STANLEY ELECTRIC MANUFACTURING COMPANY, OF PITTSFIELD, MASS., AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK.

The arrangement of these thermal storage tanks in connection with the boilers is comparatively simple. The tanks are simply plain, cylindrical boilers, but, of course, they must be capable of sustaining a pressure fully equal and generally much greater than the working boiler. The working boiler is run full of water and is made to deliver a constant stream of hot water into the storage tanks, independent of the rate at which the steam is drawn from them, and for the best results this system should be run at, at least, 100-pounds pressure in excess to the pressure required at the engine.

We now come to the fourth method for supplying our sudden demand for steam, which was originated by the author. This is probably the most economical manner of solving this problem; first, as regards the original cost of the equipment, and, secondly, as regards cost of operation. By this system the number of boilers required are reduced, the quantity of water needed is much less, and this consequently lessens the amount of fuel required, and the consumption of steam at the engine is also reduced. Of course, we will need for this system boilers which can be safely operated under high pressures; and let us here (for the sake of comparison with the example we have given under our second system) suppose that we have in our new plant two water-tube boilers, each having a rating of 250 horse-power and running under 300-pounds pressure, supplying steam to our 500-horse-power rolling-mill reversing engine, which is designed to work with 80-pounds pressure.

In the first place, we will be obliged to place reducing valves in our steam main, between the boiler and engine. This will probably require more than one valve, as there is too great a range in pressure between 300 pounds and 80 pounds to be successfully handled by a single valve. The object of these reducing valves is to receive the steam from the boiler at a pressure higher than that required at the engine, and by means of throttling reduce this higher pressure to the 80 pounds required. The fall in pressure at the boiler side of the valves may run all the way from the 300 pounds down to almost 80 pounds, but the pressure on the reduced side of the valves will always remain a constant 80 pounds. Steam at any higher pressure than 80 pounds will only cause a waste of steam at the engine on account of the high terminal pressure at the end of the stroke. This, of course, refers to our reversing engine, while with an automatic cut-off engine too high an initial pressure will cause, towards the end of the stroke, the wasteful negative pressure which, on the indicator diagram, will be shown by the terminal loop. Returning to our rolling-mill engine, which is exhausted to the atmosphere, the terminal pressure, of course, increases as the initial pressure is increased about 80 pounds. Thus it will be seen that reducing valves are a source of great economy in such practice. These reducing valves must be very large, larger than required in ordinary practice.

As for the difference in expense in running boilers at a pressure of 300 pounds instead of 100 pounds, it is hardly worth consideration. Practically speaking, a pound of coal will evaporate the same number of pounds of water into steam at any pressure. To show the truth of this statement, let us take a pound of steam at 100-pounds pressure, and again, the same weight at 300-pounds pressure. The total heat in the first is 1,185 heat units, while, in the latter, the total heat is but 1,209.3 heat units, a difference of only 24.3 heat units, and when we consider that our coal delivers between 13,000 and 15,000 heat units when burned, from 60 to 75 per cent of which is utilized by the boiler in making steam, no difficulty can be had in comprehending our statement that, practically, the same amount of water can be evaporated per pound of coal, irrespective of the pressure. Now, in order to investigate the working possibilities of this arrangement, let us consider our plant somewhat in detail. Taking a well known horizontal water-tube, rated at 250 horse-power, we find that,

under ordinary working conditions, it contains about 20,000 pounds of water. Two of these, making a battery of 500 horse-power, will, therefore, contain 40,000 pounds of water. As has already been stated, our 500-horse-power rolling mill engine is designed to be operated with 80-pounds pressure. The steam space and steam liberating surface in these boilers are designed to be of sufficient size and capacity to secure dry steam when the boilers are supplying the maximum demand. It must be remembered that all sudden lowering in the pressure of boilers is followed by an increased ebullition of the water, which has a tendency to project particles of water into the steam space, and if ample space is not provided to allow most of these particles time to drop back again into the water from which they have risen before the outrushing steam carries them away into the steam pipes, trouble is very apt to follow if this moisture is not entrapped or separated from the steam before it reaches the engine. The exact steam liberating surface required in a boiler is pretty difficult to define, as experimenting in this direction has not determined this with any precision, but it is safe to say that when steam is taken from the surface of water at a speed greater than three feet per second, water is generally carried with it. A curious fact has been noted in this matter and that is, after steam once begins to pick up water as it leaves its surface in a boiler, it will continue to do so for a considerable time, even though the speed of its exit is considerably less than the speed at which it first began to pick up the water. The advantages of reduced steam space have been already discussed under our first system.

Next, let us consider the amount of water required here and compare it with the second system. Here we have 40,000 pounds in our boiler, while there we had 100,000 pounds.

One pound of water under 300-pounds steam pressure contains 391.9 heat units.

One pound of water under 80-pounds steam pressure contains 294. heat units.

The difference is 97.9 heat units.

We thus find that a drop in pressure in our boiler from 300 to 80 pounds will render available, from each pound of water contained in the boiler, 97.9 heat units, therefore, with 40,000 pounds of water we will have available 3,916,000 heat units to generate quickly the steam required. Dividing this by 886.7 (the number of heat units necessary to evaporate one pound of water into steam from the temperature of water under 80-pounds steam pressure), we find that we will have generated 4,416 pounds of steam through this fall in pressure, and, as our engine requires 500 pounds of steam per minute, we find, by dividing, that we have a supply of steam which will supply our engine for 8.83 minutes, to say nothing of the steam generated directly by the fire during this interval. Thus you will plainly see that we have almost three times as much reserve energy available as in the second system, while we have but two-fifths the amount of water. It is a well known fact that water-tube boilers are very rapid steam makers, and, in consequence of this, after dropping their pressure, as has just been stated, they will commence "picking up" immediately, and the nine minutes during which they are delivering steam from the available heat they have stored in the water under 300-pounds pressure is more than ample time for them to recover their maximum pressure again, and thus the desired result is accomplished.

(To be continued.)

## THE DESIRABILITY OF A STANDARD SOCKET.

TOPIC DISCUSSED BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW YORK, MAY 7, 1896, BY ALFRED SWAN.

(Concluded from page 265.)

In addition to their offending in this respect, they are objectionable in that the use of the plaster which we know is bad, electrically considered.

They are clumsy and heavy, by reason of their large size, and, to sum up, all are needlessly expensive, the cheapest costing not less than six dollars a thousand, while I am fully warranted when I assert that one-third of this sum might, and eventually will, provide a suitable and appropriate fitting.

Manifestly, therefore, a standard lamp base must be the first point for determination—a standard not merely accepted as such, but one that by virtue of its essential merits shall be fairly and fully entitled to such recognition—a standard that shall accomplish the nearest approach to finality possible in that direction.

Having accomplished that, the rest necessarily follows—a lamp base involves a socket to suit it.

Having got the best and cheapest lamp base that is possible, no other, in time, would be used, and hence, as a corollary, arrive at our standard socket.

I am not aware of the revolutionary character, which in some of its aspects this movement may appear to assume, nor do I fail to appreciate the practical difficulties which necessarily confront any and every attempt to cope with this standardization question, but, I submit, where the need for amendment is so palpable and the call for that amendment so imperative, as in this case it is, difficulties must needs be met and overcome.

This is not the question for solution by mere process of elimination or survival—in which case it might be left to work its own cure; it is, in my opinion, a matter involving radical change and a new departure.

In view of the fact that high tension lamps are in all probability going to be the rule in the future, the question of a safe socket acquires enhanced importance.

Porcelain will, no doubt, come largely into use for this purpose, and this will greatly modify the conditions now governing the lamp base, and will make possible that simplification and economical change in this regard which I have already indicated; and, as even a small saving on the cost of a base becomes a considerable item in the aggregate, it is in this direction, therefore, that economy and improvement should be most encouraged.

In this connection I might mention that the idea lately occurred to me—and I since find that others have put forward the same idea—to engineer this matter economically by means of a detachable form of basis—a form of base, that is to say, admitting of repeated and continuous use, thus saving expense on renewals.

I have come to the conclusion, however, that that idea, though apparently all right in theory, would not operate satisfactorily when reduced to commercial practice; for, even were this made possible by returns on the part of customers—and this is very doubtful—the allowance necessary to induce those returns, added to shipment and other charges, would go far to neutralize any saving there might otherwise be.

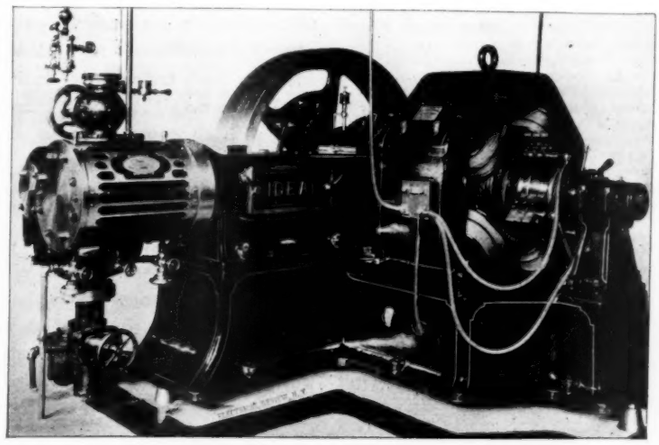
Regarded from the commercial standpoint, therefore, I come to the conclusion that the most practical and satisfactory solution of the matter is the form of the base, or mount, so inexpensive that when the lamp is destroyed the base may be allowed to go with it, as in itself a thing of no value. And it is to this form of base that I allude in the foregoing, and to which I shall later more particularly refer.

In practice all lamps would, in such case, be fitted at the time of their manufacture with this inexpensive mount, and would so be stored complete and ready for shipment at a moment's notice, the manufacturer, the supplier and the consumer all participating in the advantages that would certainly attend this simplified order of things.

The commercial benefit that would undoubtedly follow in the train of this standardization of the lamp alone makes that end worth striving after, for that present complicated and vexatious state of things operates to retard the progress of electric lighting, and is there detrimental to its industrial interest. can not be denied.

But the purpose of these remarks is not, at this moment, the advocacy of any specific form of base socket that will follow; their object, as stated at the outset, is to take the sense of this representative gathering, first upon the main question at issue—that is, the question as to the desirability of a standard socket—and next, should that question be affirmatively met, to determine, if possible, a line of action that shall best conduce to the desired end.

But, in conclusion, I would urge than any resolution on this question at which this convention may arrive shall not lose sight of the fact that a standard base is the kernel of this matter; not merely a base chosen as a standard from one of the prevailing type, but a base which is yet to be evolved—one that shall in all respects fulfill standard requirements and so give us as its completement our standard socket.



HARRISBURG "IDEAL" ENGINE DIRECT CONNECTED TO EDDY GENERATOR, AS EXHIBITED AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK. THIS UNIT IS SHOWN IN OPERATION, AND IS SUPPORTED AT THREE POINTS WITHOUT ANY BOLTING.

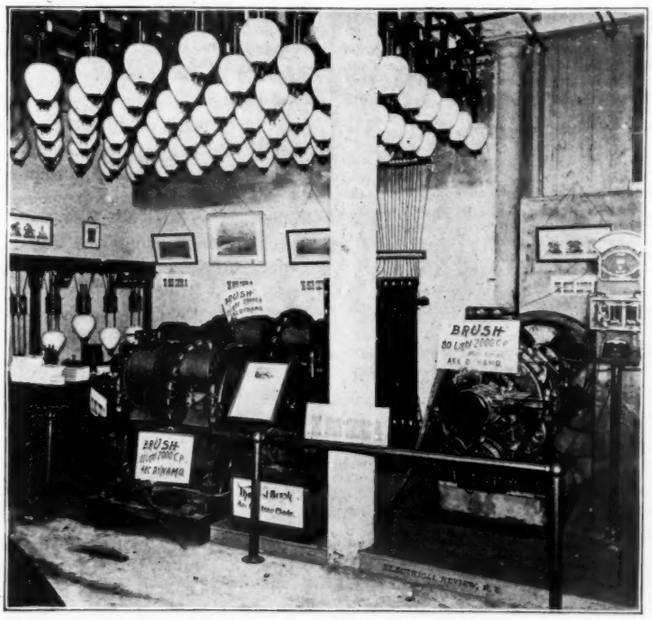



EXHIBIT OF THE BRUSH ELECTRIC COMPANY, OF CLEVELAND, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK.

ELECTRICAL REVIEW

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SPECIAL NOTICE TO ADVERTISERS.

***CHANGES** for advertisements must be in this office by Friday noon for the following week's issue.*

***NEW ADVERTISEMENTS** should be in the office not later than Saturday noon to insure publication the following week.*

NEW YORK, MAY 27, 1896.

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These are lively electrical times. The two giants, Edison and Tesla, may be said to be bestirring themselves.

At last it is announced that all the Chicago Exposition medals are to be sent out. Let's see, was it three or four years ago when this Exposition was held? The medals at this late day have certainly lost much of their value.

*THE EDITOR'S RESPONSIBILITY.*

The ELECTRICAL REVIEW believes in the "freedom of the press." It is always pleased to uphold any contemporary in its efforts to maintain its right to freely and fairly discuss public matters. But this privilege does not permit of the publication of untruthful and libelous statements.

The Electrical Exposition has just been the victim of a cowardly and false attack by a newspaper whose editor has been one of its professed friends. Such treachery is doubly repellent to the right-minded editor, who, with an appreciation of the influence his work exerts, carefully confirms, as far as possible, his statements before giving them editorial publicity, after which there can be no adequate retraction or remedy. Erroneous statements, in this busy life, will sometimes slip into the news columns, but for the editorial page, where careful consideration precedes publication, such excuse can have but little weight.

If the editor of the *Electric Railway Gazette* had desired to deal justly with the interests for which he pretended friendship, and had extended to the well known gentlemen and responsible companies interested the slight courtesy of a hearing before publishing charges of fraud, he would not now be writing abject apologies nor appearing as defendant in a libel suit.

Professor Roentgen, in his second article, announces that all solid bodies can generate the X rays under the influence of the cathode rays, the only difference being as regards intensity. Platina produces the most intense. The Tesla apparatus, he further states, introduced between the ray-producing apparatus and the Rhumkorff coil, is highly advantageous. Roentgen, like Edison and Tesla, throughout this interesting work has not hesitated to give to others the credit properly due.

The New York *Herald*, one would think, is big enough to give credit where credit is due. Yet in its issue of May 21 it published an article about Tesla's vacuum-tube lighting, every material fact of which was taken from an article that appeared in the ELECTRICAL REVIEW the day before. Several sentences were stolen bodily. The golden rule is evidently pigeon-holed in the office of our daily contemporary.

A street railway monthly published in Chicago makes an uncalled-for and silly attack on the National Electric Light Association. We think an apology will be promptly forthcoming, if the journal in question retains any of its influence among the street railway interests that it pretends to represent.

*EXPOSITION COMMENT.*

The faithful laboratory assistants of Mr. Edison, Messrs. Fred Ott, Charles Brown and Clarence Dally, who are running the Roentgen X-ray apparatus at the Exposition, are artists in their line. Obliging, attentive and thoroughly competent, with unceasing good nature, they have so managed that the thousands who eagerly visit the exhibition every night are smoothly and comfortably passed along, and privileged in each case to participate in a trial of the workings of the X ray. One of the gentlemen operates the electrical apparatus, another one guides the hand of the visitor to the screen, and Fred Ott, in clear-cut tones, instructs the line of visitors to be in readiness as they approach, keeping everybody in good humor. All this takes place in a dark, mysterious and awe-inspiring room, a red incandescent lamp giving just light enough for people to pass along without discomfort. The indefatigable Luther Stieringer is ever present, cool, calm and imperturbable, quietly seeing that everything runs smoothly, and that distinguished visitors, who are flocking from all over the city and country, receive proper attention. The visitors to this part of the Exposition the first night, Monday, May 11, although it was unknown to most of them, were privileged to witness the work of the rays with Mr. Edison himself manipulating the apparatus.

The ELECTRICAL REVIEW believes that to no one man is the success of the Electrical Exposition more indebted than to Mr. Thomas A. Edison. When at 11 o'clock P. M., Saturday, at the close of the first week of the Exposition, and its success in point of attendance was still in doubt, he threw off his coat and declared that his X-ray apparatus (which had stubbornly refused to work all that evening) would be complete and in running order by Monday or he would "eat it," it meant that the general public would yet become intensely interested in the Exposition, and that the large attendance which has greeted it would have this substantial motive for its presence. We believe that every exhibitor and every official of the Exposition properly appreciates the efforts of Mr. Edison, who, with his laboratory assistants and Messrs. Stieringer, Osterberg and others, labored all night Saturday and all the following day until 10 o'clock at night to accomplish the success finally obtained. This X-ray exhibit, which Mr. Edison has most ingeniously arranged so that the public can conveniently witness its practical workings, has proven a drawing card for the general public, and from 8 o'clock until 10.30 o'clock every evening an immense crowd is in line, passing rapidly through the dark room where the brilliant bulb is performing its fascinating and weird functions.

The Exposition crowds are constantly increasing, and the quality of the attendance is remarkable. Gentlemen whose names are widely known, with their families, are to be seen in

line in front of the Edison Roentgen X-ray exhibit, the phosphorescent diamond, the Moore vacuum-tube-lighted booth and the Niagara Falls telephone booth.

The most brilliantly lighted exhibit is undoubtedly that of the Brush Electric Company when all its arc lights are illuminated. The effect is really startling.

One of the quietest and most level-headed members of the Executive Committee is Mr. E. F. Peck, whose work has been of an unobtrusive and most essential nature. He and the suave and always good-humored Cyrus O. Baker, Jr., comprise a conservative team that combines well with the enthusiasm and earnestness of other members of the Executive Committee.

The executive work of Mr. Marcus Nathan, general superintendent, has been without flaw or blemish. This quiet and potential individual has made a record for all time in his handling of his department of the Exposition, and has contributed in no small degree to its success.

### THE FINANCIAL SIDE.

Growing confidence that the country will be under the enlightened rule of a sound-money President and Congress during another four years, combined with an excellent crop outlook, has changed sentiment in speculative circles during the week and closed prices materially higher. Business is still dull, although it is healthy.

The great topic of interest in electrical circles just now is the rapid transit situation. The decision of the Appellate division of the Supreme Court, knocking out rapid transit underground scheme undoubtedly throws that matter into the hands of the Manhattan Elevated. The temper of the public, however, is such that it will no longer be trifled with by this corporation. If its managers terminate their dilatory tactics and make some earnest effort to improve their system of transit, they will be met half way by the Rapid Transit Commission. If they do not, a new elevated system will be the result. One of the first lines of improvement would be electrical equipment. The decision referred to renders this more certain now than ever.

Another development in this field is the practical certainty that the Metropolitan Traction has closed negotiations for a lease of the Madison avenue horse car line from the New York & Harlem Railroad Company, at a rental to start at 4 per cent per annum and to increase at the rate of ½ per cent per year until the maximum of 5 per cent is reached. The electrical equipment of this line will follow within a short time, the idea being to relieve the congested traffic on Broadway.

One of the New York dailies on Saturday morning had a story in effect that President Vreeland, of the Metropolitan Traction, made a statement, concurred in by Mr. W. C. Whitney, that the Lenox avenue electrical equipment was unsatisfactory, and that the system would not be used on the other surface lines. A number of mysterious hints were also published as to a new motor which would be installed on all the lines within a year.

I am informed that President Vreeland denies having made any such remarks. My authority states the question of insulation presented the only real difficulty. This has now been overcome by the use of porcelain insulators. The road is being operated exclusively by the system, to the extent of 30 cars per day, at a cost of 9 cents per car mile, and is giving entire satisfaction. As evidence of this may be cited the fact that the equipment and system have all been paid for and new cars are being added from time to time.

General Electric stock advanced some 2½ points on Saturday to 36½. Prior to that day the quotation was 34½. For the first time in many months Western Union issues have been active. The 5's sold between 107 and 107⅞ in quite large amounts. This reflects the general demand from first-class securities. It was also characteristic of Edison Electric Illuminating of New York first 5's and consolidated 5's. The latter sold at 104, the former at 107 to 107½.

The special meeting of the Westinghouse company, to be held in this city June 4, will act upon the proposition to increase the capital stock.

The Westinghouse company is understood to have decided to put the Tesla motors into the railway field. Arrangements have been made to discontinue some 300 patent suits pending in the courts between General Electric and Westinghouse. President George Westinghouse issued a circular, May 22, stating that under the deal with General Electric the two companies guarantee customers against patent suits on all apparatus purchased from them. The fundamental patents controlled by the two companies include those of Edison, Tesla, Thomson, Brush, Sprague, Shallenberger, Van Depoele and other inventors.

On the Boston Exchange. telephone stocks were steady to strong. Bell advanced from 205 to 206. Erie Telephone gained 2 points to 61 and New England a fraction, closing at 90¼. That center is now having a boom in copper stocks, based on the higher prices for copper, and all securities regarded as local have strengthened in sympathy. Electric Storage in Philadelphia was practically unchanged, the common closing at 34½ and the preferred at 36. Pennsylvania Heat, Light and Power was unchanged at 15. BAIN.

New York, May 23.

Mr. Nikola Tesla has been suffering from a severe attack of la grippe for two weeks past, during which time he was only able to be at his laboratory a few hours. His friends will be glad to learn that he is now improving in health. He was seen at his hotel on Monday and asked, as the originator of vacuum-tube lighting, if he had anything to say about Mr. Edison's new vacuum-tube lighting, and replied characteristically that he "had the utmost faith in the genius of Mr. Edison, and heartily congratulated him on his success as announced."

### THOMAS A. EDISON'S LATEST DISCOVERY.

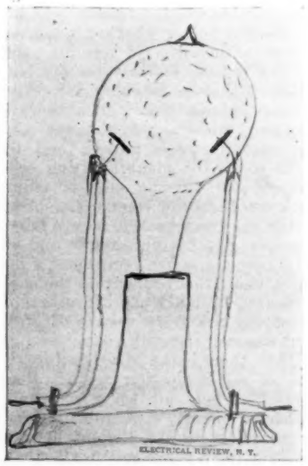
X RAYS TURNED INTO LIGHT—HE FINDS A MINERAL CRYSTAL THAT DOES IT—MUCH LIGHT AND VERY LITTLE HEAT—HE IS NOW PERFECTING HIS APPARATUS FOR COMMERCIAL USE.

Thomas A. Edison has made another important discovery, which promises to bear very fruitful results. He has found, as the result of his investigations on the fluorescence of certain

THOMAS A. EDISON.

salts, described by him in the ELECTRICAL REVIEW for April 1, 1896, a certain natural mineral crystal which possesses the wonderful property of turning X rays into light.

When a representative of the ELECTRICAL REVIEW saw Mr. Edison at his laboratory, in Orange, N. J., on Monday of this week he was very reluctant to speak of the matter, on the ground that his experiments were so recently made that he




SKETCH DRAWN BY THOMAS A. EDISON FOR THE "ELECTRICAL REVIEW," SHOWING THE CONSTRUCTION OF HIS NEW LAMP WHICH CONVERTS THE X RAYS INTO LIGHT.

had no time to make exact measurements of his results. After considerable persuasion, however, he consented to be interviewed, every now and then protesting that he had nothing to talk about.

"I have discovered," said Mr. Edison, "a certain natural mineral crystal which fluoresces even more strongly than tungstate of calcium. I take an ordinary Crookes bulb and fuse a coating of this mineral crystal on the inside surface of the bulb. The connecting wires are carried in glass tubes to the sides of the bulb and are sealed in the usual manner. The electrodes used are made of aluminum. Then I simply substitute the new bulb I have thus prepared for the Crookes tube in my regular X-ray apparatus. When the current is passed through this coated bulb the X rays are turned into light, and the absorption of this new mineral is so great that the X rays are almost all absorbed and turned into light with very little heat. The bulb gives off a pure white fluorescence. When the coating of crystals is fused on the inside surface of the bulb no X rays can be detected.

"What I have succeeded in doing is only this: Instead of generating X rays and throwing them off into space, I have turned them into a pure white light of high refrangibility. It seems as if practically all the electrical energy is transformed into light. To the eye, the light is pure white, resembling bright sunlight. It has none of the moonlight effect. The spectroscope shows, however, that there is plenty of red in it, and it is, therefore, a normal light.

"I can make these new lamps of any size, and the efficiency of the X-ray apparatus used with them can be made very high. I can also run a number of these new lamps in multiple arc.

"I am now at work on endurance tests of the bulbs and am working to get the system into simple commercial form. Eventually the whole system can be worked on the regular 110-volt incandescent circuit. The best bulb I have yet made gives off four candle-power.

"The mineral I use to coat the inside of the bulb is very cheap, and I doubt if this system can be beaten for transforming electrical energy into light. The whole system is highly economical.

"I hope to be able to get time to show these new bulbs to a few scientific friends at the Electrical Exposition on Wednesday night."

At the receiver's sale of the Electric Heat, Light and Power Company at St. George, Staten Island, Saturday, the plant was bought by Erastus Wiman for $110,000. Mr. Wiman, before his failure, was the leading man in the company, and is said to have bought the property for heavy Boston mortgagors. The plant is to be improved and extended.

## ELECTROLYSIS.

TOPIC DISCUSSED BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW YORK, MAY 7, 1896, BY CAPTAIN WILLIAM BROPHY.

As you well know I have not prepared a paper, but this subject has been on my mind for a long time, and I can not easily get rid of it, so that it is not necessary to place much of it on record. With the advent of the arc light came the same line of construction that had been adopted by the telephone and telegraph companies. The first few lines that were put up were composed of bare wire, carried on the same style of insulator pole and fixture. This was soon dispensed with, and an attempt was made to insulate the wire. That attempt has not, I regret to say, been improved upon very much up to this day. The "insulation" used as a rule for overhead wires is called so by courtesy; but an attempt to cover these wires, exposed to the atmosphere, with a costly insulation, would be folly, as there is nothing that will withstand the changes of atmosphere and temperature.

For some years previous to the attempt at placing wires underground, the telegraph companies had successfully operated their lines to some extent both under ground and under water. The so-called early types of insulation for electric light circuits consisted of a cotton braid, one or more coats of braid placed on the wire, and this braid treated with a covering of plant, whose only virtue was that it rendered the covering non-inflammable. As an insulator, when wet, it was an absolute failure. When dry, it passed very well. I believe the Underwriters' were responsible for this grade of insulation. They thought that the only provision they had to make to prevent conflagrations from the electric current was to have something on the wire that was non-inflammable. It was rightly christened "Underwriters' wire." Some irreverent fellow has since then called it "Undertakers' wire."

The first attempt to place wires underground, other than the telegraph wires, was made in Chicago by Professor Barrett, the city electrician, who was obliged, owing to the remonstrances of the residents in a certain neighborhood, to place some of his fire-alarm wires underground. This he did in a crude way. From that day he had the underground bee in his bonnet. He has, however, done some good work in that direction since that time. He placed many of his fire-alarm wires underground. They have operated successfully for a number of years and are operating successfully to-day. These earlier types had no lead covering. Later on the city of Chicago and Professor Barrett determined that all wires should go underground, and that electric light wires amongst the rest should be buried. Chicago, or rather the people in the electric lighting business in Chicago, paid dearly for the series of experiments that were tried in that city. Other people throughout the country profited by it. I will not enumerate the vexations and expenses that were incurred in that Windy City.

The earlier wires were laid in wooden pipes, wooden troughs, pump logs and various types of cubic pipes; and I think to-day there can be found almost any kind of duct and insulation in that city. In the city of New York Mr. Edison laid a complete system of underground conductors. This system has proved fairly successful. The present types of ducts are numerous, but the one most extensively put down is cement-lined sheet-iron pipe laid in a bed of concrete, through which the cables, either lead-covered or plain, are drawn. Manholes at different points are placed for convenience in drawing these cables through the ducts, connections being made therein to each separate length.

The problem of laying arc wires underground and operating them successfully was not an easy one, and I must confess is not yet completely solved. It was quite a different one from placing telephone and telegraph wires underground and operating them successfully. In the first place there was very little demand for that kind of conductor and very little incentive for the manufacturer to produce it. As a result nearly all the early attempts at placing them there and operating them were failures. However, as the individual referred to in the last paper (the tax-payer) and others kept prodding the electric light people, one city after another has seen fit to compel both the wires to go under ground. Notably, the city of New York. You are all familiar with the history of that attempt. You are also familiar with the autocratic powers placed in the hands of the Board of Electrical Control. The companies here know how heavily that weighs them down, and how cheerfully they would have that load taken from their shoulders.

The reasons for going under ground are numerous. First comes the public demand; the public knowing little or nothing of the difficulties or the cost of placing wires under ground, but they insist on their going there, as they insist on getting light for nothing. Next the politician, the man who is elected as Mayor and has his head brimful of new ideas. He either seeks to place all the wires under ground, or to build a municipal lighting plant, and through that means stop the "robbery of the taxpayers" by the local electric light company, as it appears to him. Then the legislator, who, when he first visits the State house and feels the weight of responsibility and the eyes of his constituents upon him, who thinks himself in duty bound to introduce some kind of a bill, no matter whether it passes or not, or whether it is good, bad or indifferent. It gets his name in the papers, and assures his constituents that he is doing something to earn his money. Then there is the very important factor, the competitor, sometimes nursed, and too often so, by the manufacturing companies, who, for the sake of selling their goods, throw commercial honor to the winds, and sell it to any fellow who can give his note for it, and set up a dynamo, a few lamps and a few poles, and either sell out to the older company, or make its life miserable by wiping out every vestige of profit that was ever in sight.

Then there is the other factor, the one of self-protection against these pirates. There are some companies who have already, without being asked to do so, requested the privilege of placing their wires and ducts under ground. It is my opinion that this is a wise step in many cases. After the companies have gone to that expense and secured the right of way through the streets, these little pirates are generally kept out.

The next thing is to prevent the establishment of that other popular fad, now known as a municipal lighting plant, which means another name for a nursery where little statesmen for a cent can be spawned readily, where the ward heeler finds an easy job and a safe resting place until there is a change in the administration. The cost of producing light can never be ascertained in such plants. If it costs too much it is charged to some other department. Some time or another it may leak out, but I do not think that I shall live long enough to see it. As a matter of simple justice, I must say that all these plants are not carried on on these lines, but there are so few of them that do not, they are hardly worth mentioning.

Having now been compelled, as we will assume, to go under ground, what are the difficulties to be met with. After placing your wires under ground, if there are no stray currents to disturb them, you are reasonably safe for a number of years, for the manufacture of insulated cables for underground work has now been brought to a very high state of perfection and you can get almost any required degree of insulation. But, unfortunately, in this country, while we want everything of the most approved type and where, in order to get it, we will run almost any risk, we have, co-existing with the electric light, the single trolley electric street railway system, which has done wonders in building up cities and towns and bringing people with small means within the reach of comfortable homes, where they can get a reasonable amount of fresh air and God's sunlight. The horse, as a motive power for propelling street cars, is fast disappearing. It was a pity that the rail of the street railway was adopted as a part of the circuit, and those who introduced it in the early days little knew what the consequences would be. The first to feel the effects of this was the Bell Telephone Company. They fought vigorously for their prior right to the earth. (Laughter). In passing, I may say that they have maintained almost all of it. But the courts decided that they were not entitled to the whole of it. Consequently the street railways have taken a large slice. This compelled the telephone company to abandon the earth as a part of their circuit and increase by 100 per cent the amount of wire in the air. This increase was so great in many cities that it would become difficult to see the sun if it continued, and the birds could not fly down and sing for us. With wise forethought they have solicited and obtained in most large cities the right to lay their wires underground, most of them being laid in lead covered cables.

For special reasons it is found necessary to produce a cable of very low static capacity for telephone purposes. The best, the one which is now generally adopted, is that of an insulation of dry paper, which gives a high degree of insulation and at the same time a low static capacity. These desirable results are obtained by this style of insulation, but it depends wholly on the continuity and perfection of the lead for its life. Dampness passing through the lead, by reason of injury, mechanical or otherwise, of course, destroys the insulation of all the wires within the cable. After the telephone company took the earth, and not being able to hold the whole of it, as I have already stated, they took a portion of it in which to lay these cables. They found their arch enemy after them again—the electric railway. Owing to imperfect bonding or to the lack of conductivity of one side of the circuit, these large currents sought and found the earth; in other words, the potential of the earth was raised at places distant from the station, and was lowered again within the radius of a half or a quarter of a mile, more or less, depending largely on the state of the soil on which the station was built. There the earth's potential became lower than the cables; these lead-covered cables affording a much easier path to the negative side of the dynamos than some portions of the earth. Large volumes of current were conveyed through them. No difficulty occurs at the point where the current seeks the cable; but at the point where it seeks to leave the cable, where the earth's potential is lower, here the trouble begins.

Electrolysis? What is it? Can it be prevented, and how? Electrolysis proceeds on the same line and under somewhat similar conditions as the well known method of electro-plating; the moist earth being an immense electro-plating bath of various resistances, while the lead covering of the cable, metal gas and water pipes are the negative and positive poles. Corrosion of the metals, due to the action of the electrolytic current, goes on as surely as fate. There is a difference, and perhaps a wide one, between the working effects of an electro-plating bath and the destructive corrosion of iron and lead pipes and lead-covered cables. All currents of electricity flowing into the earth seek the best conducting medium, and causes the destruction of the latter at the point where it seeks the earth again.

The cause of the corrosion of metals is due to the following conditions: A thin film of water surrounds these metals and it is decomposed into oxygen or hydrogen by the electric current. Oxygen, when freely released, is always intensely active in combining with any metal present. The lead covering of the electric conductor within the ducts, or buried in the earth, is, as a rule, covered with a thin film of water, and it is not infrequently the case that the ducts and manholes are filled with water also. In every case the lead takes the place of the positive and negative plates in the electro-plating bath. If the current of electricity, after traveling along the surface of the lead, leaves it to seek a point where the earth's potential is lower than that of the lead, it decomposes the water, and the free, nascent oxygen immediately enters into combination with the lead surface to produce lead oxide in the form of a paste, and iron oxide or rust in iron. The crust of oxide being permeable by water, a fresh surface of the metal is in contact and presented to the moisture, and the process is continued indefinitely, until the lead covering is destroyed. The amount of metal thus decomposed depends on the amount of current flowing from the metal to the ground, while the potential may be as low as one-tenth of a volt. From a group of telephone cables running by the Albany street power house of the West End Street Railway Company, Boston, have been taken 500 amperes, which would decompose about two and five-tenths pounds of the metal in 24 hours. To lay pipes or electric light cables underground under these circumstances and expect them to possess any lasting qualities, would be the height of folly. What is the remedy?

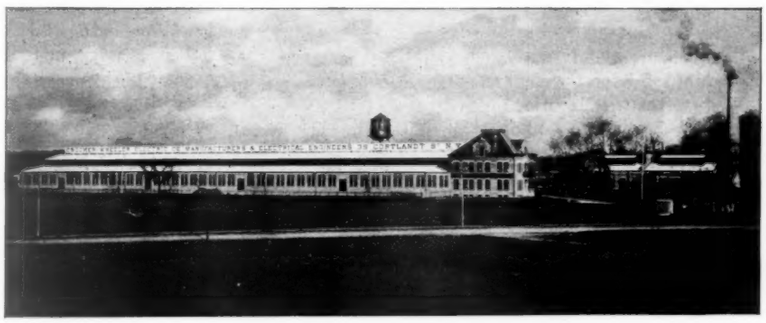
The only real remedy is to cease using the rail as a part of the circuit and use a metallic circuit. But to bring this condition of affairs about is a task not easy of accomplishment. The courts have already decided that the electric railways have a perfect right to use the earth, if they see fit. The only remedy, then, will be, if the water systems of cities and towns became endangered, for the people of these municipalities to seek redress, and they can possibly obtain it. Now that we have the electric railway with us—and we would not part with it under any circumstances—let us do what we can under the present condi-

tions to reduce this present evil. Public opinion has now arrived at that stage when it will demand the burial of wires in congested districts. I apprehend in Massachusetts that in all our large cities the initiative will be taken immediately to do so, the companies doing it voluntarily themselves or being compelled to do so by law. Boston is obliged to do it by act of the legislature. It seems a little unjust, after the State Legislature or City Council compels a company to place its wires—for reasons of public safety—beneath the ground, that it should not protect that property after being placed there. Still I see no easy way of doing that at the present time. Under certain conditions this evil can be reduced very largely. Boston is very favorably situated in that respect. The power houses are at the extreme ends of our congested districts. By connecting the positive side of the dynamos to the trolley we have confined what is known as the danger district within a radius of less than half a mile from the station. The method that has been adopted there is to provide an easier path to the negative side of the dynamos for the current flowing over the cables than the earth; in other words, to run out very large return feeders for the sole purpose of taking this current from the lead covering, and thus, in a measure, but not wholly, avoiding this corrosion on their surfaces. The stations, too, are situated in low, marshy ground, and for that reason we are enabled to accomplish this with a very little outlay of copper. If, on the contrary, a power station is built on a rocky foundation, and that extends to any great distance from the station, it will be necessary to extend these return cables beyond that rock formation. In any portion of the town or city where the potential of the earth is higher than the cable, no trouble will exist, but where the earth's potential is lower than the cable then the trouble begins. If all cities were like Boston and Worcester, it would be an easy matter to remedy, in a measure, this evil; but it can never be wholly remedied or removed in this way. The earth's potential in some places is very low indeed, and it would be difficult, perhaps, to cause all of the current to flow to the negative side of the dynamos over another path.

The cost of this remedy depends largely, as I said before, on the conditions of soil surrounding the power stations. No doubt, there are places where the cost would be so great that it would be useless to attempt it, and it would be better at once to use the metallic return instead of the rail and ground. In Boston we have reduced it very much. I find by making tests the day before I came away, even with all the precautions that have been taken (and, in justice to the West End Railway Company, let me say that they have done everything they know how to do, to prevent this trouble, freely and without hesitation) we are not really able to say to-day that all our cables in the vicinity of the power house are safe from corrosion due to electrolysis.

I have sometimes thought, and think so now, that in some cities, particularly where coal is cheap—cheaper than copper, even cheaper than rail bonds—that it will be impossible to use lead-covered cables in certain portions of such cities; and it seems to me that the manufacturers of cables will have to bestir themselves to find something for a better protection to the insulation of the wires placed under ground than lead or other metals unless the street railways adopt an entirely different mode of construction. The perfect bonding of rails has proved a problem which has not yet been solved. While a bond may be perfect to-day, six months hence it may offer so much resistance as to render it almost useless by the electrolytic action in moist earth between the two metals—copper and iron—so that I place no confidence in many rail bonds now in use. There have been many suggestions and plans made by which this difference in the potential of the earth could be overcome by means other than the one I have described, but they are expensive and very few of them have been put in operation.

In conclusion I must say that if you are obliged to go underground, and obliged to use lead-covered cables, in justice to those engaged in the electric lighting business, the authorities who oblige you to do so, should protect your property, after they have compelled you to place it there.



THE FACTORY OF THE CROCKER-WHEELER ELECTRIC COMPANY, OF NEW YORK, AT AMPERE, N. J.

### The Brooklyn Bridge Plant.

The trustees of the Brooklyn Bridge have decided not to permit the elevated roads to pass over it. They have also determined to install their own electric plant. A contract was awarded to the Babcock & Wilcox Company for a battery of two boilers to cost $4,350. The original boilers used by the bridge are of this manufacture. The Southwark Foundry and Machine Company, of Philadelphia, received the contract for two 600-horse-power engines, costing $16,400, and the Pullman Palace Car Company for 20 cars to be equipped with electric motors at a cost of $3,200 each. The two electric generators are to be furnished by a Cleveland company, represented in New York by Mr. H. McL. Harding, formerly with the Westinghouse and Sprague companies.

Trains are to be run on one-minute headway when all these improvements are completed.

The Lehigh Valley Railroad is changing its primary batteries and adopting the Gordon-Burnham cell.

### The Crocker-Wheeler Electric Company.

The extensive works of this company, illustrated on this page, are located at Ampere, N. J., just outside of the city of Newark. A very large number of the attendants at the recent convention of the National Electric Light Association visited these works and enjoyed an evening's sojourn among the interesting machinery and manufactured product and that in course of manufacture to be seen on every hand.

About a year ago these works were destroyed by fire, but the enterprise of the management was not disturbed and a new factory was promptly constructed.

As has been stated in the ELECTRICAL REVIEW before, these works are noted for the use of electric power throughout; each tool is operated by its own motor as part of the frame. This admirable feature saves shafting, belting, etc., and with the deep cement floor, on which the heaviest machinery can stand without special foundation, makes the factory a thoroughly modern and well-thought-out one.

## KIND WORDS.

AN APPRECIATIVE READER.

TO THE EDITOR OF ELECTRICAL REVIEW:

I want to congratulate you and the rest of the REVIEW staff on the original articles which have appeared in the paper during the last few weeks from Edison, Tesla and others. I hope it has proved as desirable a feature to other people as it has to me, and that it will increase the circulation of the paper accordingly. Certainly nothing, since the invention of the telephone, has awakened as much interest as the recent discoveries, and even that did not spring into prominence all of a sudden like this. I am not much of a journalist, but I should imagine that original articles like those would attract a great deal of attention to the paper and materially assist in establishing it in the good will of the people you want to reach. J. G. SLONECKER.

Topeka, Kas., May 8.

Cheap telephone service is in practical demonstration at Shelbyville, Ind. A mutual company is said to be maintaining an adequate and satisfactory service there with 225 subscribers at $1 a month. This system applies not only to the city, but to the adjacent country as well.

# TELEPHONE NEWS AND COMMENT.

The Bell rates at Muskegon, Mich., have been reduced from $30 to $24 a year.

The Bell telephone wires in St. Louis will be put under ground within six months.

It is said that the unsubscribed balance of the 21,500 shares of American Bell Telephone Company's stock is about 5,000 shares.

Contractor George S. Smith, of Elizabeth, N. J., has begun suit for $15,000 against the Elizabeth Telephone Company. The company tried to establish lines and compete with the New York & New Jersey Telephone Company. Smith contracted to put up a portion of the line for $27,500. He received $12,500, but by the time he finished the work the projectors of the scheme had given it up.

The directors of the Erie Telegraph and Telephone Company have elected Mr. Charles J. Glidden to the office of vice-president. Mr. Glidden will, for the present, hold the offices of vice-president and treasurer. Mr. Charles A. Grant, for the past 13 years general cashier, has been elected assistant treasurer and Mr. George B. Perham, secretary. The company sent out on May 14, to 1,566 stockholders, dividend No. 50.

Treasurer Alonzo Burt, of the Missouri & Kansas Telephone Company, on May 15 mailed quarterly dividends of his company to the stockholders for the three months ending April 1, 1896. Under the careful management of President J. R. Mulvane, Secretary Ferguson, and Treasurer Burt, this company is one of the solid telephone companies of the country and is strongly intrenched in the leading cities in its territory. The company's head office is in Kansas City, Mo.

The Copenhagen Telephone Company, which now boasts one of the most perfect installations in the world, had at the end of last year 4,196 direct subscribers' lines to the central station, the increase during 1895 having been 637, against 556 during the previous year, says London *Engineering*. To central stations in provincial towns in Sealand there were 1,151 direct subscribers' lines, making a total of 5,347 direct lines. In Sealand there are altogether 6,624 telephones, averaging one telephone for about every 130 inhabitants. There have been carried on 15,200,000 conversations during the year at the Copenhagen and neighboring central stations, averaging a cost to subscribers of three to four öre (about ½*d.*) per conversation; the number of conversations shows an increase of 50 per cent, as compared with 1894. The shareholders receive a dividend of seven per cent, and a very substantial sum is added to the reserve fund.

## ELECTRIC RAILWAY NOTES.

The New Haven road will extend its Nantasket electric road from Old Colony House station to Hingham. The third rail is now being laid. As soon as terminal facilities at Boston are increased the electric road will be continued to that city.

The property of the Meriden, Waterbury & Connecticut River Railroad will be turned over to the New York, New Haven & Hartford road by June 1. After that date the Meriden road trains will not connect with the New England station at Waterbury, Ct. This is greatly resented by Waterbury residents. A New Haven despatch says that the Meriden road will be equipped with electricity at once, probably after the style of the Nantasket branch.

Another electric street railway line has been added to the rapidly increasing list in Massachusetts. It was opened to the traveling public on May 15. The new line is known as the Milford, Holliston & Framingham Street Railway. It extends from South Framingham, where it interseots with the South Middlesex line of electrics, through a small section of Ashland to Holliston Center, thence to Milford. The distance is 12 miles. Trips are made every half hour from early morning until late at night; the fare is 15 cents.

A few days ago the Pennsylvania Railroad made a speed test of the Mount Holly electric road, and in a run of six miles made a measured mile at the rate of 73 miles per hour. F. W. Darlington, who acted as electrical engineer for the Pennsylvania Railroad in the construction of this trolley system, when seen by a representative of the ELECTRICAL REVIEW, said that he believed this test demonstrated the entire practicability of the system, as in this test no special preparation was made and the road itself is a short one and does not give an opportunity for reaching great speed.

The Syracuse, N. Y., Rapid Transit Railway Company was incorporated on May 21. The company, which is believed to be a reorganization of the Syracuse street roads, announces that the length of its lines is to be 57.69 miles. The capital stock is $4,000,000, consisting of $1,250,000 preferred and $2,750,000 common stock. The directors of the new company are: John Alvin Young, of Jersey City, N. J.; Ansel L. White, George F. Brown, David N. Darling, John B. Summerfield, Edward T. Perine, William H. Chesebrough, Jr., and S. R. Lawrence, of New York city; and Edward N. Tobey, of Brooklyn.

## Col. H. C. Adams.

Col. H. C. Adams has resigned his position as manager of the New York office of the Fort Wayne Electric Corporation and will devote all his time to the affairs of the Union Traction Company, who are building an electric trolley road from Arlington and Newark to Hackensack, N. J. His New York office will be at 39 Cortlandt street.

## Insulated Wire Companies at the Electrical Exposition.

The wire companies are ranged along in a peaceful, compact and interesting row on the south side of the main hall. First comes the Okonite company's beautifully arranged parlor, the two chief ornaments (leaving out for the instant the officials of the company), being a 700-pound ball of pure Para rubber and a most artistic electrolier suspended from the center of the booth. The booth is fitted up in parlor style and the electric fans, constantly in motion, make it one of the popular, cool spots of the Exposition, where thousands of the friends of this company have, from time to time, rested and been refreshed. Immediately adjoining this and fitted up also in parlor style, but in a different way, is the very sumptuous booth of John A. Roebling's Sons Company, where easy chairs and beautiful curtains are in evidence. Samples of the wire and cable manufactured by this company, with a number of pictures on the walls, are included in the exhibit as are also a number of samples of the bi-metallic wire now being introduced by the Bi-Metallic Electric Transmission Company of this city. Immediately adjoining is the exhibit of the Bishop Gutta Percha Company, which is a very noticeable exhibit and which has been before described in these columns. Following next to this is the very large space occupied by the India Rubber and Gutta Percha Insulating Company, where every night Messrs. James Godfrey and Frank Harrington are always to be found to welcome their friends. A very artistic and striking sign of colored incandescent lamps containing the magic name of "Habirshaw" attracts the attention of every passer. The Telmic Manufacturing Company and the Williamsport Wooden Pipe Company occupy the spaces following next and then comes the extensive and highly artistic exhibit of the Safety Insulated Wire and Cable Company, which we have before described. Following this is the booth of the Standard Underground Cable Company, and adjoining is the very extensive space occupied by the well known Washburn & Moen Manufacturing Company, one of the largest manufacturing companies in the United States. This entire side of the main hall is occupied by the companies named, and when it is filled, as it is nearly every evening, with the officials of the different companies and visitors, in which the fair sex often predominate, the sight is at once interesting and lovely to behold.

## Controlling Electric Lights.

TO THE EDITOR OF ELECTRICAL REVIEW:

Having seen in your issue of April 29, 1896, an inquiry from "J. S.," if there was a switch that could be used to control lights from more than one point, I beg leave to submit the following sketch, Fig. 1, which explains itself. I had occasion a short time ago to use a switch to control a number of lamps from four points, and as it was undesirable to use the ordinary snap switches, I used baby knife switches as shown by the sketch and I believe that this is the first time that they have been used for that purpose.

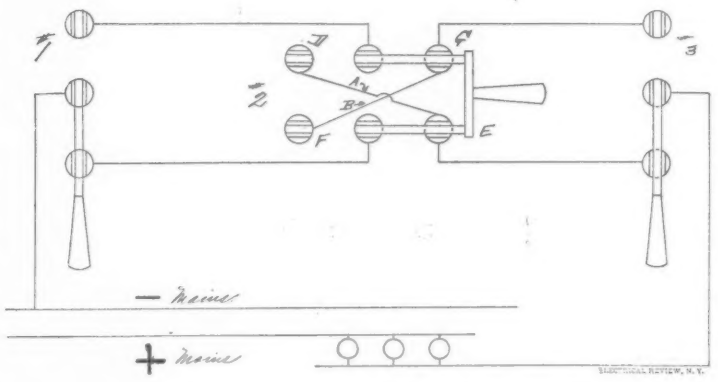



FIG. 1.—ARNOIS'S METHOD OF CONTROLLING ELECTRIC LIGHTS.

Referring to the drawing, No. 1 is a switch in the first hall, No. 2, a switch in the second hall and No. 3, a switch in the third hall. The wire A is run on top of slate or porcelain from the binding post D to E. The wire B is run on the bottom of slate or porcelain from the binding post F to G. For any number of additional points add double-pole double-throw switches. Yours respectfully,

ALEXANDER ARNOIS.

Philadelphia, May 4.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your issue of April 29, "J. S." asks for a device whereby an incandescent lamp may be turned on at one point and turned off at another.

I have used with success the following device shown in the drawing, Fig. 2. When the two switches M and $M^1$ are on the points $a$ and $a^1$

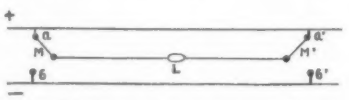



FIG. 2.—A FRENCH ELECTRICIAN'S METHOD OF CONTROLLING ELECTRIC LIGHTS.

(on the same side of the circuit), or both on the points 6 and $6^1$ the light is out. When at the place where the switch M is you place M on the point 6, and the light is on. When at the place where the switch $M^1$ is, you place $M^1$ on $6^1$ and the light is on.

Yours truly,

ELECTRICIEN.

Paris, France, May 11.

## "Of Special Interest."

The New York ELECTRICAL REVIEW of last week was of special interest, devoting a large amount of space to illustrations and descriptive matter relating to the great Electrical Exposition in that city.—*Barnesville, Ohio, Republican.*

## SINGLE-PHASE, SELF-STARTING SYNCHRONOUS MOTORS.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW YORK, MAY 6, 1896, BY F. H. K. LEONARD, JR.

Every central station manager who operates an alternating plant has to grapple with the question of power distribution. Applications for power service come in from every direction, and in many cases, properly worked up, would make a more remunerative business than that of furnishing current for lighting purposes. It is perhaps unnecessary to point out that the bulk of the lighting service averages but a few hours per day, whereas the motor service covers a much longer period, with a corresponding reduction in cost of the current output. The difference is so great that many stations are furnishing current for motor service at 50 per cent of the price for lighting service, and even then figure that the motor business is the more profitable.

To secure this business and meet the demand for power service many of the alternating stations have installed special 500-volt direct-current generators and erected additional lines, but such a system is limited by the expense of such extension, necessarily paralleling other lines already constructed for lighting service. Under such conditions a remunerative piece of business is often refused on account of the first cost of the extension necessary to reach the customer.

The many advantages of the single-phase, alternating-current system have led to its adoption in the great majority of the central lighting stations of the United States, notwithstanding the objections that (aside from a few inefficient fan motors of a fraction of a horse-power) no motors practical for general power distribution were obtainable for use on this system. This objection, however, no longer obtains, as there are alternating-current motors now made to operate on the single-phase circuits for ordinary lighting transformers, without the use of special starting devices, condensers or connections, which not only equal the best direct-current motors in commercial efficiency, but are superior to them in point of regulation, reliability and freedom from burnouts. With such a motor, which can also be used as a rotary transformer, the single-phase alternating system has every advantage of the low-tension direct-current system, besides which it is much superior in simplicity, flexibility and adaptability for long-distance distribution. So that to-day arc and incandescent light, heat and power are distributed from the alternating system at a distance of a fraction of a mile or at thirty miles or more, controlled, regulated and metered with equal facility and perfect satisfaction to the customer.

The single-phase alternating-current motor has been to the electrician, like the panacea of the alchemist, the cause of almost endless thought and experiments; but the solution of the problem was a most simple one, and rests on two well known principles. Attempts have been made to use induction motors on the single-phase circuits, but it is difficult to stop them and usually very cumbersome, and expensive arrangements have been devised which give but small starting torque. Besides this, to make

them at all efficient and keep the power factor within reasonable limits, a very small clearance or air gap (often as little as one-quarter millimeter, or one-hundredth of an inch) must be allowed between fields and armature, so that the slightest mechanical wear or vibration causes trouble. Even under the most favorable conditions it is impossible to construct an induction motor so as to avoid a very considerable lagging or so-called "wattless current." In such motors the power factor, which is the ratio of the real to the apparent energy, varies from 20 to 50 per cent. That is to say, if the motor has a power factor of 50 per cent, there must be double the current furnished that is actually required to do the work; and while half the current is wattless, yet it uses up capacity in generator, transformer and line wire, with energy consumption due to $C^2R$ losses in each, and in long-distance transmission the impedance (which is the only drop plus that due to the induction of the line, and which varies with the current and frequency) cuts such a figure as to make the expense for copper large in order to keep the working electro-motive force within proper limits.

Pacinotti's discovery of the reversibility of a dynamo applies to alternating current machines as well as direct, except that the alternating current generators, when used as motors, must be brought to synchronous speed before it will fall in step with the generator, and further, must have its field excited with direct current usually from a separate source. It will then operate as a motor, and is the most satisfactory motor that can be produced when constant speed is required. Its efficiency is the highest; quite as high as that of direct-current motors of equal capacity, while the regulation is perfect. So long as the generator with which such motor is connected runs at a uniform speed, the motor must run at a proportional speed, dependent on the ratio of the poles to the alternations; every impulse of the generator advancing the armature of the motor one pole. The motor can not change its speed any more than if it were mechanically geared to the generator, unless it is overloaded to a point where it is impossible to carry the load, which point is usually about 50 per cent in excess of the normal capacity of the motor. This is accomplished without the introduction of any lag or power factor, the load being practically non-inductive—like a load of incandescent lamps—provided the proper excitation is maintained. Furthermore, by over excitation the synchronous motor may be made to perform the office of a condenser and compensate for lag or inductive load, and can be carried so far as to induce a negative lag or lead, at the same time raising the electro-motive force of the line.

The drawback to the single-phase synchronous motor has heretofore been that it could not be started without some other source of power and would not carry its load up to speed. Motors are now made in which this is entirely overcome. They start up under load, and can be specially wound to give much greater torque in starting than when running in synchronism.

This brings us back to the two simple, well known principles, before referred to, which are combined in this motor—the principle of the ordinary alternating-current synchronous motor with that of the direct-current motor, or generator. The armature has two distinct windings—one, a distributed winding connected to a commutator similar to that of a direct-current motor or dynamo, which in this motor is used for starting and afterwards for exciting the field. The other winding is of the shuttle type, wound so as to concentrate distinct and regularly alternating poles in the armature and perform the regular work of rotating the motor armature, advancing it from one pole to the next with each impulse of the generator.

An ordinary double-throw switch on top of the motor is used in starting, there being no resistance or other complicated device, as the self-induction of the windings is sufficient to choke back any abnormal flow of current. In starting the switch handle is depressed so that the lead wires which conduct the alternating current from the transformers are connected through the switch-blades to the contacts which lead the current first to one of the commutator brushes, thence through the distributed armature windings and out through the opposite brushes to a coarse wire winding on the field poles and back again to the switch contacts and binding posts, these connections being identical with those of a direct-current series motor. As soon as the current is turned on the motor commences to rotate at a constantly accelerating speed until synchronism is reached, which is indicated by the lighting of a lamp located on the switch at a dull red. This is the signal for the reversal of the double-throw switch, which then changes the complexion so that the leads from the transformer are cut off from the commutator and connected to the collector rings and concentrated armature windings, while at the same instant the commutator brushes are connected to the shunt-field windings, magnetizing the field with direct current; the only office of the commutator, after the motor is started and up to speed, being to supply the small, direct current necessary to magnetize the field.

In starting without load, the motors will run up to synchronous speed in from five to 15 seconds, depending upon size, winding, etc., and which load in from 15 to 30 seconds, taking about the same current in either case, the time factor making the difference in the power consumed; the current taken under these conditions amounting to from 25 to 50 per cent in excess of what the motor will require when running in synchronism. But when only required to start itself or light counter-shafting, this current may be greatly reduced by special windings.

The direct-current winding delivers a perfectly smooth current, and is not at all pulsating in character. In circuit with the field winding is a rheostat to control the extent of field excitation. This rheostat is located in a recess in the base of the motor, the handle for its regulation being accessible through the oval opening at the commutator and pedestal. The motor, starting switch and field rheostat are in one piece, making a most simple and compact combination. All that is necessary to install the motor is to connect the secondary wiring of the transformer to the two binding posts on the motor, and it is ready for operation.

The general design of the machine is substantial and symmetrical, with graceful curves sweeping from point to point, giving the motor a very pleasing appearance. Nothing has been spared in the design and construction of these motors to make them as perfect as possible, and the motors are evolved from a careful consideration of the two years' practical operation of a synchronous motor, after which a thorough course of experiment was instituted and carefully tabulated to determine beyond a doubt the accuracy of the calculations for the new design. Careful attention has been given to every detail that would tend to make the motor neat in appearance and simple, so that the man without previous training into whose hands a motor usually falls, would have no difficulty in its use.

The mechanical perfection of any piece of machinery is the all-important one, and in this motor has been given the full attention it deserves. The best engineering practice of the day has been followed, and where any departure has been made it has been to make the construction more rigid and capable of resisting overload and excessive strain. The bearings are of bronze, self-aligning and self-oiling; two small rings traveling in recesses in the boxes so that they can touch the top of the shaft, the rotation of which carries the rings around, lifting, as they turn, enough oil from the chamber below the bearings to keep the shaft abundantly lubricated. As the oil is used over and over again, a single filling furnishes lubrication for months; and as the oil gets low, the rattling of the rings serves as a warning that the oil should be replenished.

The field crown is of the multipolar type, with field cores pointing inwardly. The magnetic circuit is composed of sectional sheet-iron punchings, each section including two poles, stacked so as to break joints. These punchings are interlocked and clamped between two cast-iron rings, with bolts passing through from side to side, which serve to clamp the whole together solidly, at the same time holding each punching in its proper place and tying them like links in an endless chain. The bottoms of the cast-iron rings are milled to fit the base of the motor, to which they are firmly bolted.

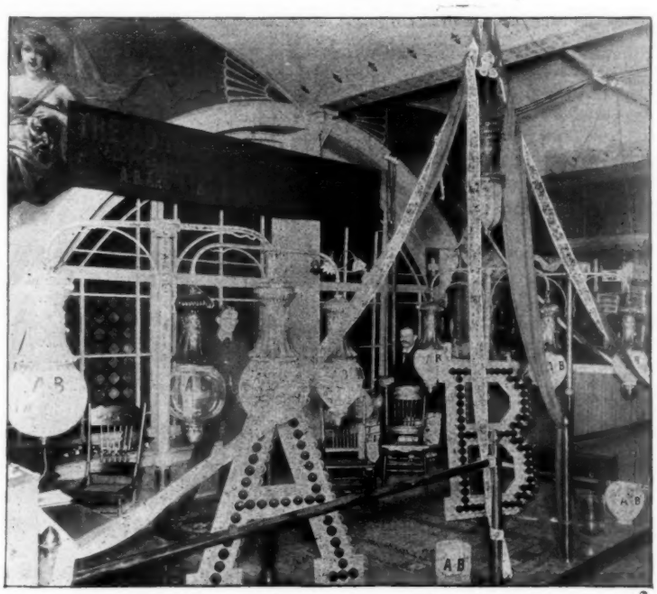
On top of the field crown is placed a starting switch, and all the electrical connections from fields, commutator and collector brushes are brought around the outside of the field punchings to the top, concealed from view, however, by the perforated steel jacket, which is held in place by grooves in the cast-iron clamping rings, forming an ornamental finish and greatly increasing the radiating surface.

The binding posts for the motor are located at the center line of the switch. Any inside wireman who has connected incandescent lamps will have no difficulty in wiring and connecting one of these motors, as the work is precisely the same as for a two-wire lighting service. The primary wires are connected through a primary fuse-box to the transformer. The secondaries of the transformer, which are perfectly insulated from the high-tension primaries, carry the low-tension currents which are induced in the transformer through the fuse-box, which is provided as an extra safeguard against the accidental flow of any dangerous current; and from there to the double-pole knife-switch, which is used to turn the current on and off from the motor. From this switch two wires connect to the binding posts of the motor. There is no multiplicity of wires or special connections for starting box to perplex a person.

The purposes to which these motors are applicable are almost without end, ranging from commercial use in labor-saving devices—such as printing presses, type-setting machines, lathes and machine tools, elevators, laundry and sewing machines, pumps, ice-cream freezers. church organs, coffee mills, sausage machines, etc.—down to twirling ceiling fans in a restaurant, where you can enjoy a comfortable meal in the heated months, or to driving a "merry-go-round," on which the children, and often the older ones, delight to ride on a holiday in the public parks or at the seashore.

As this motor runs at a constant speed, it has been necessary to devise several special arrangements to accomplish what might be done by a variable-speed motor. Motors are made for blowing church organs, in connection with which it has usually been customary to provide complicated automatic speed-regulating devices. With this motor no attempt has been made to vary the speed. The organist closes his circuit and starts his motor by means of a pedal. A blower, driven by the motor, fills the bellows and maintains a constant pressure, usually about four ounces per square inch. If no air is used, the blower spills the wind out of its fan and requires only enough power to overcome the friction and maintain the pressure. As fast as the air is used the blower takes a corresponding amount of power, the motor absorbing the current accordingly.

*(To be concluded.)*



ARC AND INCANDESCENT LAMP EXHIBIT OF THE ADAMS-BAGNALL ELECTRIC COMPANY, OF CLEVELAND, OHIO, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

## ON A ROTATIONAL MOTION OF THE CATHODE DISK IN THE CROOKES TUBE.

READ BEFORE THE ACADEMY OF SCIENCE OF ST. LOUIS, MAY 4, 1896,

BY FRANCIS E. NIPHER.

It is well known that the equations, which represent the properties of the magnetic field external to a conductor, are inconsistent when applied to points within the body of the conductor. Assuming the total magnetic force within to be tangent to a circle whose center is at the wire center, and the surfaces of equal potential are radial planes; assuming the force due to an element of the conductor of infinite length and of section $ds$ to be $\frac{2\,di}{r}$, it follows that the force at any point without the conductor varies inversely, and at an internal point, directly as the distance from the center. If now within the wire we assume any radial plane as a datum equipotential plane and determine the locus of any other equipotential surface, such that the difference of potential, measured along the lines of force, is constant, this surface turns out to be one having as a cross-section a spiral known as the lituus, having the radius as an external asymptote and reaching the center after an infinite number of turns. It is evident that these internal surfaces of equal potential can not be both radial planes and spiral cylinders.

Maxwell disposes of this absurdity, to which the equations lead, in the single sentence which closes section 606 of his "Electricity and Magnetism." He says: "Within the substance of the conductor there is no such thing as magnetic potential."

It has long seemed to me that this failure of the equations must be the result of leaving some elements of he problem out of the discussion. I have spent a great amount of time in seeking for some rotational phenomenon hitherto unrepresented in the equations. Until recently the results were wholly negative. While recently experimenting with a Crookes tube I observed that the circular aluminum disk of the cathode became slightly loose on the aluminum wire, and that it was constantly rocking in rotary motion on the wire. After several days of use, during which it had been decided to construct a tube with disks capable of rotation, the cathode disk suddenly became loosened and began to rotate slowly on the wire as an axis.

The bearings were somewhat rough and the disk was not perfectly balanced. It often stopped, but then began to rock against the obstacle until it again freed itself. The direction of rotation was contrary to the hands of a clock, when the disk was viewed from the point where the cathode wire pierces the wall of the tube. All attempts to accelerate or retard the motion by means of strong bar magnets, as in Barlow's wheel, were without effect. Placing the tube at various distances from the induction coil and giving the disk all possible positions in the earth's field, produced no change in the rotation. A more decided rotation was produced by using the brush discharge of a 24-inch Holtz machine. No rotation has been produced as yet when the leading wires were in metallic contact with the conductors of the Holtz machine, but when the leads consisted of rods having spherical terminals, separated by short spark intervals, the rotation was always seen. When the loose disk was made the anode, no tendency to rotation has been observed. Thus far all attempts to produce the effect in air of ordinary pressure have failed, but the work in this direction is not yet concluded.

In the tube used, the tendency to rotation was not observed until by long use the vacuum had become very high, and it has now nearly reached the limit where the sparks pass around the tube, rather than through it.

The leading-in wires are at right angles to each other in the tube used. Tubes are now in preparation which will have rotary disks facing each other as well as at right angles to each other, and various other features, by which it is hoped that many questions, which at once suggest themselves, may be answered. There is much reason to suspect that the gas particles do not shoot off normally from the surface of the disk, but in a vortex, the axis of which is in the two dark spots opposite the cathode faces. The fact that the anode does not respond, and that similar experiments in open air have thus far failed, seems to point to the cathode discharge as the direct active agent. This view is not easily reconciled with the result of the experiment made by Crookes with the hemicylindrical cathode (*Nature*, July 3, 1879, page 229, Fig. 3), but the figure shown does not seem to quite agree with the description of it. Experiments are now in preparation which will decide this question. It is possible that the rotation observed is a direct action and reaction between the current in the disk and the external field due to the current. In this case the rotation apparently ought to be producible in open air and on the anode terminal of the Crookes tube.

Whatever may be the direct agency producing this rotation, it seems apparent that we now have an experimental basis for imposing a term representing a rotation into the equations representing the conditions within a conductor.

## The New York Electrical Society.

At the annual meeting of the New York Electrical Society, held last week at the Electrical Exposition building, officers for the ensuing year were elected as follows: President, Dr. C. E. Emery; vice-presidents, Herbert Laws Webb, Gano S. Dunn, Max Osterberg, A. L. Riker, William Finn and W. W. Kerr; treasurer, Henry A. Sinclair; secretary, George H. Guy.

The members of the society visited the different exhibits at the Exposition and enjoyed a private view of the X-ray exhibit of Mr. Edison.

## A Cutting Press for Small Armature Disks.

The accompanying cut of press C2 shows a press manufactured by the Ferracute Machine Company, of Bridgeton, N. J. It is one of a series of six sizes of presses which have proved very popular for cutting out armature disks and other work in light metals. The total weight of this press is about 1,400 pounds, and it has an eight-inch hole in bed and so is well adapted for armature disks up to that size. The weight of the flywheel is 275 pounds; diameter 25 inches. There is a size smaller press of the same style, weighing 900 pounds, and four larger sizes, the heaviest weighing 8,300 pounds, and the latter will cut a disk 28 inches in diameter.

These presses are fitted up with a new form of automatic clutch and

Power Cutting Press.

improved form of adjustment, etc. They have forged steel shafts, hardened bolts and nuts, tempered steel clutch parts, and are carefully and accurately fitted up, and so they are especially adapted for cutting armature disks, which requires accuracy and durability of parts. In most cases the disks are cut in plain round blanks, with a center hole and keyway, and are afterwards notched in a special press with indexing attachment, which the Ferracute Machine Company build.

They issue a catalogue describing 300 different kinds of presses, several of which are especially adapted for electrical work. They have an exhibit of their presses at the New York Electrical Exposition, space G, 152, Forty-fourth street side of building, and the press above mentioned, and also the indexing attachment for notching are running in their space.

The Calumet Electric Street Railway Company, of Chicago, has increased its capital stock to $4,500,000. The company was incorporated in 1890 with a capital of $50,000. The road has now about 80 miles of single track electric lines in the suburbs of Chicago, its power-house being located at 94th street and Drexel avenue. Its total capital now is $500,000.

## Chemistry that Pays.

[*From London Lightning.*]

Professor Dewar's lecture at the Royal Institution was a rapid survey of the galloping pace at which chemical discovery of value in the arts has lately proceeded. It was a complete justification of Mr. Ludwig Mond's dictum that chemical research spells commercial success. Take, for instance, what Mr. Mond himself has brought to light and utilized through his attempts to improve the gas battery first invented by Lord Justice Grove. The suggestion that carbonic oxide might be used in some way led Mr. Mond to discover a strange and totally unexpected property of this gas, namely, that it will directly unite with metallic iron and nickel to form gases which are called carbonyls of those metals. Could anything be more strange than the idea of iron as gas at an ordinary temperature? And could anything be more valuable? For as soon as you heat these carbonyls they give up the metal again with the greatest facility. The result is that Mr. Mond is now using carbonic oxide to extract nickel from its ores. He gets nickel carbonyl as a gas, subsequently heats it to make it part with its nickel, and sends back the carbonic oxide to extract some more. In this way pure nickel can be obtained, for the gas will only pick up the nickel. Professor Dewar also described the famous Castner process for getting pure soda from common salt. Here we have electrolysis at work once more, but with a movable electrode in the shape of a flowing stream of mercury, which bears away the metallic sodium in amalgamic solution as fast as it is separated from the salt. The amalgam then passes into water, where the sodium dissolves as hydrate, leaving the mercury free to go round again. But there is something more than this. As the sodium dissolves it generates electricity. Formerly this electricity was generated in the electrolytic bath itself, and obstructed the operating current by setting up a back electro-motive force. Now, the current being separately generated, is made to travel the right way, and to supplement, instead of obstructing, the working current. Finally Professor Dewar illustrated the discovery of the effect of the oxides of the rare earths, such as those of zirconium, thorium and lanthanum, in transforming heat into light. This is the principle of the incandescent gas burner, invented by Von Welsbach, which is made by saturating a cotton mantle with salts of these metals and then incinerating it. The organic cotton is all burnt away, leaving nothing but a skeleton mantle of oxides and silica. When these are suspended in the colorless flame of a Bunsen gas burner they glow in the fashion now so familiar, far surpassing the incandescence which can be obtained from platinum, magnesium, lime and other substances heated to the same point.

Mr. C. A. Bragg, Philadelphia representative of the Westinghouse Electric and Manufacturing Company, visited New York last week.

## RECENT DEVELOPMENTS IN VACUUM TUBE LIGHTING.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, APRIL 22, 1896, BY D. McFARLAN MOORE.

(Continued from page 278)

Turning now from the mechanical construction of vacuum vibrators to consideration of their unique properties from a scientific standpoint. As stated before, roughly speaking, the prime object of making the break of the current in a vacuum is to produce an increased C. electro-motive force over that resulting from an air-break. But I venture to say, few as yet realize the possibilities and the tremendous advantages involved in the separation of electrodes in high vacua at regular periods of time. It is indeed questionable whether the increased C. electro-motive force of the ether gap is responsible for the results. It is more probably due to the fact that the wave lengths of the current resulting from an ether gap differ radically from any that have heretofore been known of. Recognition of the importance of this phenomenon led me to use the word "etheric" in connection with my system of tube lighting, because the light is directly dependent upon what I designate as the ether gap of the vacuum. Our best notion of the separate existence of the ether is formed by thinking of that which remains within a vacuum of the highest degree we can produce. It may have been noticed, that so far I have not used the word "phosphorescent." It is undoubtedly a misnomer as applied to tube lighting; but to make matters worse, there seems to be no word in existence exactly or even approximately suitable.

The word etheric is especially applicable to light produced by the ether gap. That incomparably better results should be obtained by using a vacuum as a dielectric seems to be in perfect accord with accepted theory which has largely been upheld by actual experimentation. For example, setting aside for the time being that part taken by the magnet, let us consider only the break—the spark.

First, what is required is a continuance of the rapid oscillations of an electric discharge, and I desire to show that this is accomplished by a vacuum vibrator in an ideal manner. One method of obtaining an oscillating discharge is to use a potential such that an air-gap of considerable width is bridged by the spark. But the manner in which such discharges succeed each other largely depends upon the irregular movement of the air within the gap.

This method is unsatisfactory for many other reasons, among them the very objectionable high tension required, but there remains the conductive method of causing a spark, exemplified in the ordinary vibrator and induction coil. Here the sparks in the primary circuit can be made to succeed each other quite rapidly, but the length of time required for each complete break is long. However, with the vacuum vibrator, a new and simple device, the conditions are different and so are the results. Here the dielectric is an exceedingly thin film of ether, which is capable of withstanding a great electro-static strain, but, when it does break down, it does so very suddenly; that is, it may be considered a perfectly disruptive discharge, and, therefore, its single oscillations are very short; but, as a whole, they are long continued. This means that the frequency is high, and, according to Maxwell, very high-frequency oscillations are probably identical with light.

The small magnet, being a circuit of induction has its own natural period. But its period and moment of inertia will be less, the less its capacity. That is, the smaller the magnet the smaller the period, or the higher its frequency can be.

But to have an intense light, there is required a high electro-motive force of self-induction. This the small magnet furnishes, because what is lost in self-induction by using a comparatively few turns of wire is more than made up by the suddenness of the discontinuance of current flow, and the fact that the high vacuum precludes the possibility of loss to the self-induction ordinarily due to the glow discharge which precedes the disruptive discharge in the air. The self-induction also depends on the amount of current flowing through a circuit when interrupted, and this the vibrator provides for, in that all the current which flows through the coil does not pass through an arc, but is transmitted over actual metal contacts. Also since these contacts are so very close, due to the thinness of the dielectric, the oscillatory discharges do not leave the metal and pass in objectionable minute streams through the vacuum. And the number of oscillations in the coil and the amount of light, depend in a measure on energy expended to overcome the resistance of the dielectric which is almost infinitely greater than that of air.

That the silent discharge prevents long continuance of oscillations is shown in the Hertz experiments, where the experiment fails unless the balls of the electrodes are kept polished. That the vacuum vibrator is nearly ideal is again shown in that these troubles are almost entirely eliminated. The ether is undoubtedly the ideal medium in which to disrupt an inductive circuit for conversion into light. Since an exceedingly thin film (if this term may be so used) is a dielectric of such strength that a very small displacement results when it is disrupted, and the ether being the medium of minimum rigidity closes the "hole" the instant it is pierced. Such a medium for such a purpose is almost incomparable to air or oil, which becomes volatilized.

In order to get any oscillations, more sudden rushes of current must occur on discharging than on charging, and the more nearly these equal each other, the quicker the rushes will succeed each other. Now, in the case in question, when the tube circuit with its condenser coatings has a certain capacity, the self-induction of the magnet can be so varied that these two will always neutralize each other, and then the critical strain on the dielectric requires but little energy to cause a discharge, and the circuit being almost balanced, the surges follow each other in rapid succession through the tube. The surges continue for a longer time, since the energy of the discharge is not dissipated in heat on the air, but is conserved to be utilized in prolonging the existence of the oscillations. The use of this vibrator seems to afford the best means yet invented for impressing molecular disturbances in a tube. The longer the oscillations exist, the more nearly the mean oscillation approaches a constant period, and this period is practically governable as compared with that of currents due to magnetic blasts or heated air currents. The higher the frequency, the greater the mean free paths of the molecules, because a less number of molecules will then be required to cause a given number of collisions, and the less the number of impacts, the greater will be the light in proportion to the heat. But the frequency is dependent on the capacity of the condenser, which, in the case of the tube coatings, is very small.

THE HANDSOME CARBON EXHIBIT OF HUGO REISINGER, OF NEW YORK, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

When the self-induction and capacity are properly proportioned, and the rate of the vibrator is the same as the natural period of the coil, or any of its harmonics, then there is resonance, and the maximum amplitude of each impulse will be constant. In this case the current flow is at its maximum, but so also is the voltage at the ends of the tube, as well as the quantity of light produced with a minimum expenditure of energy. The velocity of the lines of force produced by an oscillatory discharge is supposed to be equal to that of light, but its wave lengths are exceedingly greater. But this disparity is greatly reduced by the vacuum vibrator. This accounts for the intense light in the tube at comparatively low potentials and indicates that nature's keyboard has been struck to the tune of 500 trillions of waves per second, and that this rate is maintained by the fundamental mechanical vibrations of the vibrator—about 100 per second—a most beautiful demonstration of nature's wonderful compass. But not only is more light produced by the vacuum vibrator than was heretofore obtainable, but there accompanies it many other advantages of particular importance. Three of these can be mentioned: First, simplicity and greatly reduced cost of apparatus; second, the obviation of impracticable potential, and third, a very marked advance in economical production. The first heading, simplicity, has already been dwelt upon. Compare an inexpensive magnet, not as large as one's hand, and a vibrator the size of one's finger, attached to commercial currents, with apparatus costing thousands of dollars, consisting of a high-speed alternating dynamo of many coils, oil transformers, disruptive discharges with magnetic blast, induction coils and condensers. The many seemingly unsurmountable difficulties encountered with this method are almost completely overcome by the simple expedient of the ether gap. Or, referring to ordinary induction coils, the vacuum break affords a means for obtaining from the few turns of comparatively coarse wire results not obtainable with mammoth and expensive coils, made of many miles of wire, and capable of creating enormous differences of potential.

The second heading is essentially a practical one. It has often been argued, to the detriment of tube lighting, that, since it was admitted by its supporters that enormously high potentials were absolutely requisite to cause any appreciable amount of light, that, therefore (and the argument was logical), the whole idea was extremely impracticable unless some new insulator be discovered that could cope with the high potentials, so difficult, dangerous and expensive of generation and manipulation as to prohibit their use commercially. But with a current endowed with such properties as are given it by a vacuum tube vibrator, no new insulator is needed.

A light now results many times brighter than that formerly due to millions of volts, able to pierce several inches of hard rubber, or produce a spark many inches in length, from a current transmitted to the bulb or tube over ordinary flexible cord, and whose sparking distance is less than one-sixteenth of an inch. Neither can any shock be felt from such a current. Another example of the comparative ease with which this new current can be insulated is apparent in the magnets, wound in the ordinary manner, in striking contrast with the necessity for expensive and cumbersome oil transformers. In this light the exclusion of all gaseous matter does not seem to be a matter of such vital importance.

(To be continued.)

### The Carbon Electric Generator Company.

The Carbon Electric Generator Company has been organized under Maine laws with a capital of $5,000,000, and directors as follows: William H. Forbes, Charles P. Bowditch, Alexander Cochrane, F. G. Webster, Robert Winsor, W. W. Jacques and Charles A. Stone, of Boston. Mr. Stone is of Stone & Webster, electricians; Messrs. Webster and Winsor are of Kidder, Peabody & Company; Dr. Jacques is the inventor, and the others are directors of the American Bell Telephone Company. The company will exploit Dr. Jacques's apparatus for the generation of electric current direct from coal. The apparatus was described and illustrated in the ELECTRICAL REVIEW for March 11 and May 20, 1896.

### Westinghouse Special Meeting.

A special meeting of the Westinghouse Electric and Manufacturing Company will be held in New York, June 4. Books were closed on May 25 and will reopen June 5.

# ELECTRICAL ENGINEERS.

## The American Institute of Electrical Engineers Holds Its Annual Meeting.

DR. LOUIS DUNCAN RE-ELECTED PRESIDENT—NAMES OF OTHER OFFICERS—PAPERS READ AND DISCUSSED—REVIEW OF THE PROCEEDINGS—SOME POINTED OPINIONS ON VACUUM TUBE LIGHTING.

The annual meeting of the American Institute of Electrical Engineers was held at the Electrical Exposition building, this city, Tuesday, May 19. Officers were elected, which, with those holding over, are as follows:

President—Dr. Louis Duncan, of Baltimore.

Vice-presidents—C. P. Steinmetz, Harris J. Ryan, W. M. Stine; holding over, A. S. Hibbard, Dr. M. I. Pupin, W. F. C. Hasson.

Managers—John W. Lieb, Jr., F. A. Pickernell, William L. Puffer, L. B. Stillwell; holding over, terms expire 1897, A. E. Kennelly, Charles S. Bradley, William D. Weaver, W. B. Vansize; terms expire 1898, Charles F. Scott, Carl Hering, Bion J. Arnold, Dr. Cary T. Hutchinson.

Secretary—Ralph W. Pope.

Treasurer—Geo. A. Hamilton.

The report of the council for the year ending April 30 is given in abstract below:

The council has held 10 regular meetings and one special meeting, at which the average attendance has been 10. The general meeting of the Institute was held at Niagara Falls, June 25 to 28.

Prof. F. A. C. Perrine has been appointed local secretary for the Pacific coast. In this capacity Professor Perrine has rendered efficient assistance in caring for applications for membership received from that region.

Prof. W. M. Stine was appointed to fill the vacancy caused by resignation of B. J. Arnold.

A Committee on Incorporation, of which Mr. W. B. Vansize is chairman, was appointed in December, to consider the incorporation of the Institute and any changes in the rules that might be necessary. The whole matter was carefully investigated and the Institute was accordingly incorporated March 16, 1896, under the laws of the State of New York.

The total membership at the close of last year's report was 944, classified as follows:

| | | |
|---|---|---|
| Honorary members | 2 | |
| Members | 281 | |
| Associate members | 661 | |
| | 944 | |
| Associate members elected May 1, 1895, to April 30, 1896 | 143 | |
| | 1,087 | |
| Restored to membership | 3 | |
| Total | | 1,090 |
| Resignations | 17 | |
| Total deaths | 5 | |
| Dropped as delinquents | 16 | |
| Elections canceled | 3 | |
| Elected but not qualified | 14 | |
| | | 55 |
| | | 1,035 |

Leaving a total membership of 1,035 on April 30, 1896 (a net gain of 91), classified as follows:

| | | |
|---|---|---|
| Honorary members | 2 | |
| Members | 333 | |
| Associate members | 700 | |
| | | 1,035 |

The reports of the secretary and treasurer showed a balance on hand in the general fund May 1, of $239.99; and in the building fund $939.48.

The Institute met again Wednesday, May 20, and listened to the reading of the following papers, which were quite generally discussed:

Report of Sub-Committee on "Standards of Light," by Dr. Edward L. Nichols, Clayton H. Sharp and Charles P. Matthews, of Ithaca, N. Y.

"An Analysis of Transformer Curves," by Charles K. Huguet, of Pittsburgh.

"Effect of Temperature on Insulating Material," by George F. Sever, Ambrose Monell and C. Langdon Perry, of New York city.

"An Experimental Study of Electromotive Forces Induced on Breaking a Circuit," by F. J. A. McKittrick, with Introduction by Dr. E. L. Nichols, of Ithaca, N. Y.

"The Production of Electrical Energy for Office Buildings, with Particular Reference to the Plant of the Chicago Board of Trade," by Bion J. Arnold, of Chicago.

### THE DISCUSSION.

At the general meeting, which was called to order by President Duncan at 10.30 A.M., the teller's report was read by Mr. Wolcott, giving the results of the letter ballot for the election of officers for the ensuing year.

Dr. E. L. Nichols then presented a preliminary report of one of the sub-committees on "Standards of Light," of which he is chairman. This report was exceedingly timely, for the reason that both the National Electric Light Association and the Association of Edison Illuminating Companies have recently invited the Institute to fix upon some standard that can be utilized in commercial practice. The conclusion of the elaborate report of Dr. Nichols was that the "British candle" was the least satisfactory of any standard investigated, and that none of the other standards used were satisfactory. The committee will, however, pursue another line of experiment from which satisfactory results are anticipated.

In moving a vote of thanks to the committee for the work performed, Mr. J. W. Howell dwelt upon its importance, and offered his hearty co-operation in any researches to be made in the future.

An opportunity was then offered for a discussion of Mr. D. McFarlan Moore's paper on "Vacuum Tube Lighting," which was read before the Institute, April 22. Owing to occupation of the entire evening session at that time, in the reading of the paper and the exhibition of the light, there was no opportunity either to interrogate the inventor or criticise his work. The discussion on Wednesday was opened by Mr. Charles P. Steinmetz, who called attention to the amount of energy (about seven and one-half horse-power) used in the illumination of the hall, giving as he believed inferior results.

Mr. Carl Hering believed the author to be correct in his assertion that what was wanted was not "candle-power," but actual illumination. He called attention to the superiority of the arc over the incandescent lamp for the economical production of light, but that on account of intensity of the luminous arc the incandescent lamp was found superior for ordinary interior usage.

Prof. W. A. Anthony dissented from this view, and also commented upon the actual illuminating capacity of the vacuum tubes as he had seen them on the occasion referred to. He had found it more difficult to read than would have been the case with a number of incandescent lamps representing the same amount of energy.

In one case where a single tube was used on the platform with a reflector behind it, and apparently under the best possible conditions, he could not see to read as well as he could by the single incandescent lamp on the reading desk at practically the same distance from him, at a time when all other lights in the room were turned off. He was also of the opinion, in spite of Mr. Moore's statement to the contrary, that the seven and one-half horse-power motor was overloaded in supplying current to the 27 tubes.

Dr. S. S. Wheeler also thought that this was the case. As it appeared to him the belt was slipping.

Mr. Joseph Wetzler placed upon the blackboard a series of figures, showing that, in tests made by him, it appeared that about 40 watts were used in energizing each of the tubes, which were about seven feet in length.

Professor Anthony expressed his doubt as to the reliability of any tests made in which the instruments were in the vibrator circuit. He believed the proper way to make the tests was to measure the current supplying the motor. The efficiencies of the dynamo and motor being known, there should be no difficulty in arriving at the actual expenditure of current.

Mr. Ries said it was interesting to note that Mr. Moore's original use of the vibrating points was for another purpose, and that in the course of his experiments he had reached an entirely different result from that which he originally had in view.

Mr. Moore, in reply to the comments made, stated that the exhibition of his tubes referred to in the discussion was not satisfactory to him, as, owing to a misunderstanding on the part of his assistant, the full power of the dynamo was not available. His apparatus, he said, was then in operation on the floor of the Exposition, where measuring instruments were available and visiting members would be given every opportunity to investigate.

A paper was then read by Charles K. Huguet, of Pittsburgh, entitled, "An Analysis of Transformer Curves," which was discussed by Messrs. C. P. Steinmetz, C. T. Rittenhouse, Dr. E. L. Nichols, Charles F. Scott and C. A. Adams, Jr.

At the afternoon session the first paper read was by George F. Sever, on the "Effect of Temperature on Insulating Materials," the substances tested being oiled cloth, oiled and japanned paper, etc., used in the construction of dynamos.

The results arrived at were criticised by Mr. Steinmetz as merely showing the insulating properties of the materials tested without regard to their practical adaptation to dynamo construction where it was necessary that they should be impervious to the disruptive action of high-tension currents. He gave, as an example, the extensive use of mica, which, while of comparatively low resistance, was not readily penetrated under ordinary conditions.

Mr. Charles F. Scott stated that similar experiments were carried on in Pittsburgh by Mr. Skinner, in which, however, the materials tested were placed between iron plates. Different results from those given in the paper were arrived at, and he thought that too much stress should not be placed upon the conclusions reached by the authors.

Prof. F. B. Crocker believed that the differences were due to the fact that in the manner of making the tests described by Mr. Scott, the moisture contained in the material was so confined by the plates that it was retarded in its efforts to escape.

Mr. N. W. Perry thought that there was a generally erroneous impression in regard to the ready expulsion of moisture by heat from all materials. Workers in chemistry were well aware that in the case of certain substances much difficulty was experienced.

Dr. E. L. Nichols, representing the author, Mr. F. J. A. McKittrick, of Ithaca, exhibited a new form of galvanometer used in "An Experimental Study of the Electro-motive Forces Induced on Breaking a Circuit." Many negatives were shown, giving the actual records made by the instrument.

Mr. B. J. Arnold's paper on the "Reconstruction of the Chicago Board of Trade Plant," was discussed by Townsend Wolcott, Douglas Burnett, J. W. Lieb, Jr., E. E. Ries and others. Mr. Arnold explained that delay in completing the plant had prevented him from bringing forward the actual tests which he had hoped to present. The savings effected in its operation were not to be looked for, however, in any radical departure from well known practice, but rather in the careful study of various details, resulting in combined economy in labor, fuel, etc.

A vote of thanks was extended to the National Electrical Exposition Company for courtesies extended in providing an excellent hall for the use of the Institute.

Mr. Chas. P. Steinmetz, one of the newly elected vice-presidents, ably presided during the latter part of the closing session in the absence of President Duncan.

Professor Anthony subsequently announced that he and Dr. E. L. Nichols and Mr. N. W. Perry tested the power used and confirmed, practically, the result announced by Mr. Wetzler. Testing instruments were loaned by the Weston Electrical Instrument Company from their exhibit.

### ELECTRIC LIGHT FLASHES.

The Pawtucket, R. I., Common Council has voted to spend $100,000 for a municipal electric lighting plant.

The Chelsea Gas and Electric Light Company has applied to the Massachusetts Gas and Electric Light Commissioners for permission to increase its bonds from $100,000 to $150,000.

The union of the Edison Light and Power Company, of San Francisco, and the San Francisco Gas Light Company has been, to all intents and purposes, consummated.

The Edison Electric Illuminating Company of Brooklyn, N. Y., reports, for the quarter ended March 31, gross earning of $216,017, an increase of $81,453; net earnings of $90.004, increase $32,242; and surplus of $78,-129, increase $26,617.

## KINDRED INTERESTS

**The Burke Electrical Supply Company,** of 213 South Thirteenth street, Omaha, Neb., is a new electrical contracting house in that city and will be glad to receive catalogues and quotations on electrical supplies.

**Warren Webster & Company,** Camden, N. J., have issued a valuable booklet giving full particulars of the Webster vacuum system of steam heating, which is manufactured and installed under patents owned by them.

**The Matthews-Northrup Company,** Buffalo, N. Y., are publishing a *Postal Dictionary*, which is a neat and complete handbook of postal laws, rates and regulations. It is a very convenient and necessary publication, and its price, 15 cents, will make it very popular.

**The Electric Appliance Company,** Chicago, have succeeded in producing with a few slight changes from the regular Upton arc lamp a lamp that will burn 30 hours with a single pair of carbons. This lamp is meeting with much favor, and will, it is expected, largely displace the regular 10, 12 and 15-hour lamps. In addition to its convenience, the question of its great economy is a point which can not be overlooked.

**The Standard Air-Brake Company,** of New York, has just issued a particularly attractive catalogue. The question of brakes is intelligently and interestingly treated, and a number of handsome illustrations are presented. Every one interested in the question of brakes for street cars should have a copy of this valuable and interesting publication. The address of the company publishing it is 100 Broadway, New York.

**The Gordon-Burnham Battery Company** have received orders during the last week for a large shipment of their No. 1 glass cells for the Michigan Central Railroad, which, we understand, is to use them for track-signal work. Another large order came from their Chicago agents for a railroad running out of that city. Their New England agent called for a heavy shipment and as a result their factory is now pushed to its extent shipping goods.

**Some of the most recent** batteries equipped by the Clonbrock Company are the Edison Electric Illuminating Company, Brooklyn, 2,800 horse-power; Mt. Morris Electric Light Company, 1,750 horse-power; Newark Electric Light and Power Company, Newark, N. J., 4,700 horse-power; Jersey City Electric Light Company, Jersey City, N. J., 1,200 horse-power; Essex County Electric Company, Orange, N. J., 500 horse-power; Bronx Gas and Electric Company, Westchester, N. Y., 500 horse-power; Manufacturers' Electric Company, Philadelphia, 600 horse-power; Safety Electric Light Company, New York, 1,200 horse-power; Manhattan Electric Light Company, New York, 1,200 horse-power; Municipal Electric Light Company, Brooklyn, N. Y., 1,800 horse-power.

**The New York Belting and Packing Company, Limited,** have removed from 15 Park row to 25 Park place and 22 Murray street, New York city. The new store is located in the center of the business district, only two blocks away from the old building. Extending entirely through from Park place to Murray street, the building is spacious, well lighted and systematically arranged. The entrance is on Park place, the Murray street side being reserved entirely for shipping purposes. The tire department is a prominent feature in the new store and necessarily so, for, when it is remembered that almost every able-bodied man, woman and child in the country either rides a bicycle or aims to do so, it is easy to understand that the demand for "League" tires is urgent. But while the tire department is a special feature, ample space is reserved to exhibit a full and varied stock of belting, hose, packing, tubing, jar rings and a hundred other items of almost equal importance. The reputation of the company for high-grade goods is too well established to need comment, but it is perhaps not so well known that they have been making the same goods for 50 years, day in and day out, without intermission. The company invite their friends to call and inspect the new building.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**LOW RATES TO PITTSBURG VIA B. & O.**
The Saengerbund of North America will meet in Pittsburg, June 8th to 12th.
In pursuance of its usual liberal policy, the B. & O. R. R. will sell round-trip tickets to Pittsburg from all stations on its line, for all trains, June 6th to 8th, valid for return trip until June 13th, at one single fare for the round trip.
Tickets will also be on sale at offices of all connecting lines.
For full information address nearest B. & O. agent.

**REDUCED RATES TO ST. LOUIS.**
The Republican National Convention will meet in St. Louis, June 16. For this occasion the B. & O. R. R. Co. will sell Excursion Tickets from all stations on its line East of the Ohio River for all trains June 12 to 15, inclusive, valid for return passage until June 21, at one fare for the round trip.
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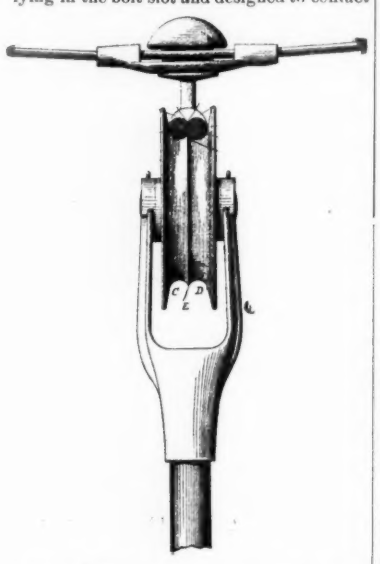
# ELECTRICAL PATENTS

ISSUED MAY 12, 1896.

560,043 Door handle with electric alarm; A. J. Moulart, Paris, France—A binding post on the door casing and a contact piece lying in the bolt slot and designed to contact



No. 550,097.—TROLLEY AND TROLLEY WIRE.

therewith when the bolt is retracted, a second uninsulated binding post and wiring connecting the posts with an electric supply and a bell interposed in the circuit.

560,076 Electric programme clock; A. A. Bastos, Brazil.

560,087 Meter for alternating electric currents; T. Duncan, Fort Wayne, Ind.—In an alternating-current meter, and in combination a coil or coils traversed by the current to be measured, a revolving secondary cutting the fields of force generated by such coil or coils in its revolutions, a magnetic path diverter, a retarding device and a registering train.

560,096 Electric call bell; F. C. Jordan, Wadsworth, Ohio.

560,097 Trolley wire and trolley therefor; H. R. Keithley, Buffalo, N. Y.—A trolley wire having two ribs and two grooves, hangers engaging one of said grooves and both ribs, and a trolley wheel engaging both ribs and the other groove.

560,098 Trolley wire and trolley therefor; H. R. Keithley, Buffalo, N. Y.

560,102 Automatic railway signal system; J. W. Lattig, Bethlehem, Pa.

560,128 Fuse cut-out; W. E. Harrington, Philadelphia, Pa.

560,168 Electric lamp socket; H. W. Leonard, New York, N. Y.

ISSUED MAY, 19, 1896.

560,193 Block and signal system; A. L. Creelman, Chicago, Ill.

560,195 Sales indicator and alarm; C. F. Davis, Missoula, Mont. — Consists of an indicator, means for actuating said indicator with an audible alarm, and connections for sounding said alarm upon the actuation of said indicator a fixed number of times.

560,212 Circuit for latent signal transmitters; P. B. Herzog, New York, N. Y.

560,216 Electro-magnetic dash pot; J. D. Ihlder, Yonkers, N. Y.—Consists of a motor and resistance device in the armature circuit thereof, a lever arm controlling said resistance device and an armature connected to said lever arm and controlling its movements in one direction, said armature moving in a magnetic field controlled by the resistance device.

560,217 Electric automatic stop for elevators; J. D. Ihlder, Yonkers, N. Y.—Consists of an electric motor and a short circuit therefor, a switch controlling said circuit and an automatic stop device controlling said switch.

560,255 Hanger for electric arc lamps; T. H. Brady, New Britain, Ct.

560,262 Head block for arc lamps; E. N. Edeburn, Cleveland, Ohio.

560,265 Electric railway system; J. C. Henry, Westfield, N. J.—In an electrical railway system where the car takes current from a pair of insulated conductors located in line with the roadway, one of said conductors being connected to and having its current carrying capacity supplemented by the track rails with which the traveling contact is not in direct traveling connection.

560,269 Electric railway; N. Leidgen, Milwaukee, Wis.—A trolley wire supporting device, comprising a hanger having curved sides for receiving the ends of the wire sections, said sides termination in upwardly-inclined cam surfaces and weighed eccentrics pivoted to said hanger for clamping the ends of the wires against said curved sides.

560,271 Registering dynamometer; G. W. Lewin, Fall River, Mass.

560,272 Connection for storage batteries; R. McA. Lloyd, New York, N. Y.—A secondary battery element having a projection and with a contact containing mercury, a copper connector secured to the projection and engaging the mercury and provided with a band of enamel between the projection and mercury contact.

560,275 Switchboard; D. M. Munro, Gaithersburg, Md.

560,284 560,370 Electric igniter for gas lighting; W. F. Rudolph, Philadelphia, Pa.

560,291 Electrical furnace; E. G. Acheson, Monongahela City, Pa.

560,313 Polar relay; T. B. Dixon, Henderson, Ky.

560,315 Electrically actuated dental plugger; J. W. Gilbert, Philadelphia, Pa.—Consists of the supporting frame formed of two parallel tubes serving, respectively, to receive the plugger handle and as a housing for the spring of the armature hammer, and the end pieces with which said tubes are connected.

560,328 Dynamo-electric machine; R. Schorch, Darmstadt, Germany.

560,340 Shunt circuit water rheostat; J. Buchel, New Orleans, La.—A water rheostat, having main circuit terminal plates and the movable shunt circuit terminal plates.

560,358 Electrical annunciator; G. J. King, Oakland, Cal.

560,360 Electrical apparatus and system; M. B. Leonard, Richmond, Va.

560,375 Power gearing for electric cars; E. A. Sperry, Cleveland, Ohio—A motor, running gear, power driving connection from the motor to the running gear, a yielding coupling forming part of said connection, and a casing inclosing said yielding coupling, said casing being integral with the journal bearing of the power driving connection

560,379 Electric measuring instrument; E. Thomson, Swampscott, Mass.

560,387 Electric arc lamp; E. J. Bagnall, Cleveland, Ohio—Consists of separating and feeding magnet of an alternating-current arc lamp and of the carbons, of an armature lever connected directly with the armature of said magnet and with the carbons, a retarder and a spring forming the sole connection between said armature lever and the retarder.

560,403 Telephone receiver; S D. Field, Stockbridge, Mass.—A telephone having a diaphragm, a permanent magnet, a pole piece of soft iron, two equal, reversely acting helices, serially connected in a circuit, one of said helices being nearer the polar extremity of the core than the other.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REFERENCES: "Electrical Review," New York; Paul Cromlein, Teller Lincoln National Bank, Washington, D. C.; Judge Geo. D. Parker, Berkley, Va.; Second National Bank, Washington, D. C.; E. K. Leech, U. S. Mint, Philadelphia, Pa.; W. F. Newell, Manager and Secretary Water Works, Olympia, Oregon.

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## SPECIAL EXPOSITION NOTES.

The following well known electrical people have been visitors in New York to witness the Exposition and be present at the Electric Light Convention: Foree Bain, the consulting engineer, Chicago; Bailey Whipple, representing the Buckeye Electric Company, Cleveland; William C. Ballda, general manager Utica Electrical Manufacturing and Supply Company, Utica; Elmer W. Gillmer, secretary and treasurer Warren Electric and Specialty Company, Warren, Ohio; William S. Jones, secretary Quaker City Electric Company, Philadelphia; John S. Bradley, secretary and treasurer New Haven Car Register Company, New Haven.

The product of the Joseph Dixon Crucible Company forms an interesting exhibit. This company has special forms of graphite for use in almost every field of electricity. Mr. George E. Long, the secretary of the company, was an interested visitor on the opening night.

The Schoonmaker exhibit was pronounced by experts the most perfect illustration of the adaptation of mica for electrical insulating shown at the Exposition. The booth contained mica in large sheets in the uncut form, mica rings, segments and washers. Mr. A. O. Schoonmaker has been a frequent caller.

Mr. Charles Y. Flanders, of Morris, Tasker & Company, of Philadelphia, spent an evening meeting friends at the Exposition.

The extensive exhibit of the Electric Storage Battery Company at the Exposition has been added to by the installation of apparatus showing the formation of storage battery plates by the Plante process. In a glass jar filled with electrolyte, two lead plates were immersed, the terminals being connected to a battery of chloride accumulators. Through a large magnifying glass, placed in front of the jar, the action of the current on the lead was plainly discernible. It proved an interesting feature to the crowd which watched it during the evening. The electric launch in the company's exhibit had a captain one evening in the person of a very small colored boy dressed in a "middy's" uniform of white duck and with the words "Chloride Accumulator" on the front of his sailor hat. The chloride accumulators furnished the current to operate the telegraph instruments that started the messages around the world, and also for firing the guns that announced the departure and arrival of messages.

The Standard Underground Cable Company have a cosy space on the south side of the main hall. The company is well represented by Manager G. L. Wiley, A. B. Saurman and Edward Sullivan, of New York. Mr. J. W. Marsh, the vice-president and general manager of the company, has also been in attendance. "A Reminder of Ohms Law" is the title of one of the novel souvenirs given out by this company. It impresses on the mind of every one who sees it the most essential primary law of the science. It can be secured at the company's exhibit, or by writing or calling at the nearest office of the company. It must be seen to be appreciated.

The impressive exhibit of the Sprague Electric Elevator Company is located on the main floor. It is safe to say that every architect and builder who has visited the Exposition has found this display the chief point of interest. Lieutenant Frank J. Sprague is present in person a great deal of the time.

General Manager Jacques, of the Murray Hill Hotel, where the electrical people are all glad to have their headquarters during the Exposition, is one of the regular attendants and has been of great assistance in supplying the various luncheons, suppers, etc., that have been required from time to time.

## American Street Railway Association.

The next convention of this association will be held at St. Louis, beginning Tuesday, October 20, and continuing four days. The building in which the convention will meet is the one erected by the Republican National Convention, and is 260x180 feet. About 80 feet of the length of the building will be partitioned off for the sessions of the convention, leaving 180 feet square for exhibits; and all entrance to and egress from the convention hall will be through the exhibition hall. There will be no choice of space, every place on the floor being equally desirable. Exhibits of like character will be grouped together, and space will be assigned in the order of application. Wires carrying current will be brought into the building from a street railway circuit, the voltage being 550, so that all mechanical devices may be operated. The income from the sale of space will go to the American Street Railway Association. The Executive Committee of the association has fixed the price at 10 cents per square foot, and ruled that no space of less than 100 square feet will be assigned, but applicants may have as many multiples of this quantity as they may wish, all in one body. Payment for space should be made to Mr. T. C. Penington, secretary and treasurer of the American Street Railway Association, 2020 State street, Chicago, Ill., on or before October 1, 1896. Application for space should be made to Mr. George W. Baumhoff, chairman Committee on Exhibits, Park and Vandeventer avenues, St. Louis, Mo. It is believed, from information already received, that this will be the most extensive exhibit of street railway supplies ever assembled at one time and place. Space must be applied for by August 15. Assignments will be made as promptly as possible after that date and exhibitors notified of their location.

It is earnestly requested that all exhibits shall be in place and all work finished by Monday evening, October 19, which is the evening prior to the opening of the convention. Possession of the hall can be had on Friday, October 16, thus giving ample time for preparation. Watchmen will be in charge of the premises, so that exhibits will be safe.

## Electric Heat-Alarms on United States Warships.

The Electric Heat-Alarm Company, 145 High street, Boston, since February 1, 1895, has equipped the following United States warships with its marine type of electric heat-alarm: "Marblehead," "Massachusetts," "Indiana," "New York," "Maine," "Oregon," and "Brooklyn." The order to equip the "Iowa" has just been received from the Navy Department.

Mr. F. S. Palmer, treasurer and general manager of the company, states that there has never been a false alarm reported at the Navy Department from thermostats installed by his company on the ships named.

A New York daily paper the other day printed a story about a fire that started in the coal bunker adjoining a powder magazine on the "Indiana" while she was docked at the Brooklyn Navy Yard. The prompt warning given by the thermostat enable the officers and crew to transfer the powder and extinguish the fire before any serious damage was done.

## LITERARY.

"Electric Wiring Specifications for Incandescent Lighting," by George H. Kimber. Cloth, 59 pp.; tables and diagrams. Price, $1.25. Sent postage free on receipt of price by ELECTRICAL REVIEW Publishing Company, *Times* Building, New York.

Mr. Kimber has succeeded in producing an eminently practical book which contains the essence of just what engineers, architects and contractors should have for handy reference on the subject indicated in the title. It is designed as a labor-saver for any one who has to do with wiring specifications. The matter is handily arranged and classified to cover a large number of cases.

## Electrical Engineer Stillwell's Statement about Niagara Falls Power Transmission.

TO THE EDITOR OF ELECTRICAL REVIEW:

The power used to operate the small Tesla motor at the Electrical Exposition comes from Niagara. During the evening it is transmitted over a circuit consisting of three conductors. Two of these are wires ordinarily used for telegraphic purposes by the Western Union Telegraph Company. The third is the earth. In technical language, it is a case of tri-phase alternating current transmission. For a time direct or continuous current was used.

When the alternating current is in use the potential as measured across any two conductors at the Niagara end of the line is approximately 500 volts. The currents are delivered to the Exposition building at a potential approximating 250 volts.

The gentlemen in charge of this undertaking have accomplished precisely what they undertook to accomplish and the transmission is an unqualified success. (Signed) L. B. STILLWELL.

The above, from one of the ablest of our electrical engineers, and a gentleman whose word in the ELECTRICAL REVIEW office, and everywhere he is known, is accepted as the exact truth, is a complete refutation of the statements in the *Electric Railway Gazette*, to the effect that no electric power is thus transmitted.

The Metropolitan Traction Company has contracted with the J. G. Brill Company, of Philadelphia, for 30 open cars, to be placed on its Broadway and Lexington avenue lines. These will be the first open cars ever seen on Broadway, and they will be welcome.

## REDUCED RATES TO PITTSBURG.

The Prohibition National Convention will meet in Pittsburg, May 27th to 29th.

For this occasion the B. & O. R. R. Co. will sell Excursion Tickets from all points on its lines for all trains of May 24th to 26th, inclusive, valid for return passage until May 30th, at one single fare for the round trip.

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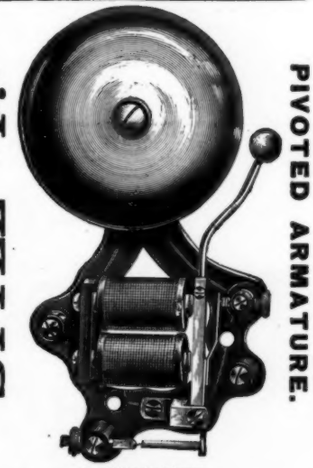


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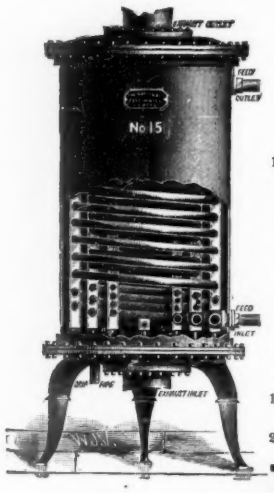


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| 300 | " | New London Street Railway Co., New London, Conn. |
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| 400 | " | Holyoke Street Railway Co. |
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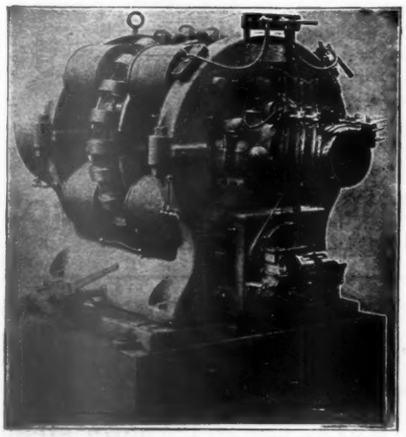

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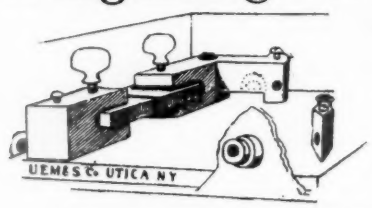


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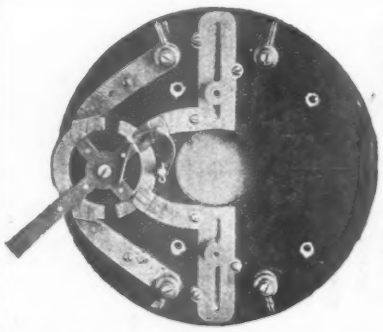

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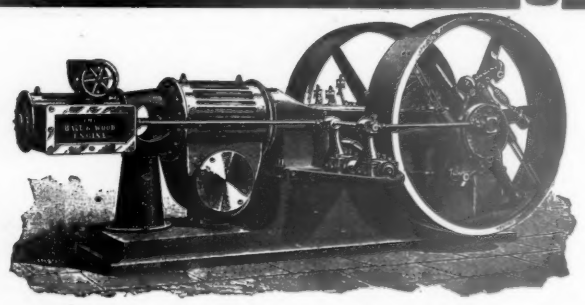

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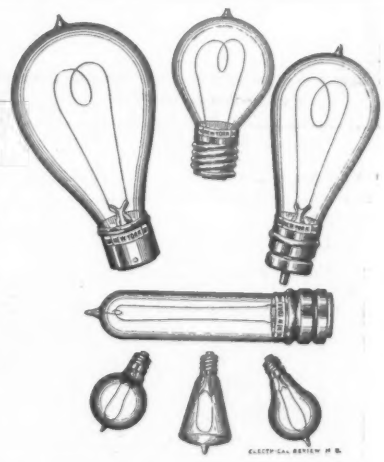

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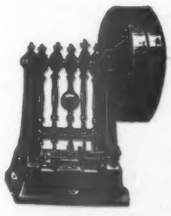

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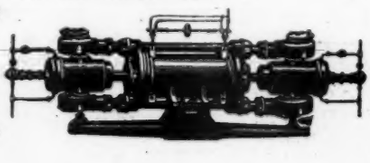

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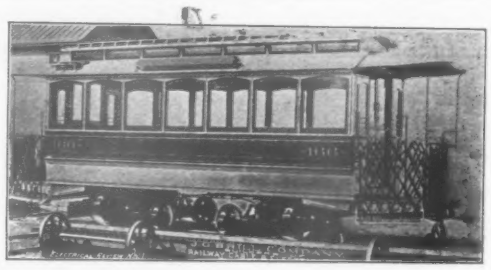

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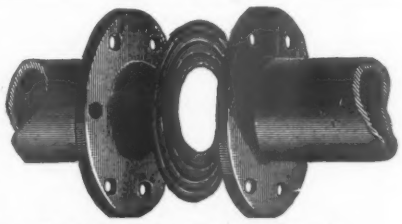

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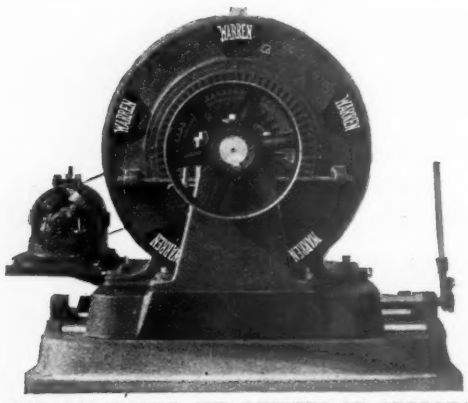


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